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☞ The writers alone are responsible for their statements.

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TO OUR SUBSCRIBERS.

FIVE MONTHS have elapsed since the publication of the first Number of "*The Sugar Cane,*" and its success is now fully assured; the number of subscribers already obtained has far exceeded our expectations, and new names are received daily. To all who have aided us in our undertaking, whether subscribers or contributors, we tender our thanks, as well as to the conductors of numerous periodicals by whom our Magazine has been favourably noticed. Though the financial condition of "*The Sugar Cane*" is thus satisfactory, it is to be regretted that we have not been favoured with a larger number of communications from those engaged in cane sugar production in various places. Whilst articles of a technological character come to hand almost in profusion, we have been somewhat disappointed in having received so few of a practical character relating especially to cane cultivation. We appeal to our friends in all parts of the world to aid us by forwarding information of this nature for discussion in our pages, and we may remind them that nothing is so valuable as the carefully verified results of individual experience. On the part of the proprietors of this Magazine, nothing will be wanting to make it increasingly valuable to all classes of its readers, and especially to those who are directly interested in the production of cane sugar.

As it is generally much more convenient to commence a new volume of a periodical with the first month of each year, we have decided that the present Number shall be the first of Volume Second, and, accordingly, have supplied a title-page and complete index for the First Volume.

ON THE CHEMISTRY OF SUGAR REFINING.

BY DR. WALLACE, F.R.S.E., Glasgow.

A DISCOURSE DELIVERED BEFORE THE FELLOWS OF THE CHEMICAL SOCIETY, FEBRUARY 4, 1869, AND REVISED BY THE AUTHOR FOR PUBLICATION IN "*The Sugar Cane.*"

(*Continued from page* 267.)

FILTRATION THROUGH CHARCOAL.

AFTER this rather lengthy digression, we return to the process of sugar refining as it actually exists. After being made clear and transparent by passing through the bag filters, the liquor is run into iron tanks or cisterns filled with animal charcoal, where it is allowed to settle for several hours, after which it is slowly drawn off below, while more of the dark coloured liquor is run on to the top, so as to keep the cistern full. As this goes on, the liquor, which comes away at first perfectly colourless, becomes after a time distinctly yellow, and the sugar solution is replaced by the syrup from a previous refine; and lastly, this is washed out with hot water until no appreciable trace of sugar can be found in the washings; then the charcoal is further washed with a copious volume of boiling water, next with some cold water, and afterwards drained, removed from the cisterns, and taken to the kilns to be reburned. Such, in few words, is the decolorizing process, which, however, I must now describe in greater detail.

The cisterns are of various forms and sizes; some are square and shallow, some of great depth, 40 to 60 feet, and so on; but the kind universally employed in the Clyde refineries are circular, and of no great depth, being generally about 9 feet diameter and 16 feet deep, and capable of containing from 20 to 25 tons of charcoal, according to its density. The cisterns are covered on the top, and are constructed to bear the pressure of a considerable column of water, or liquor, which may be applied when necessary, to cause a more rapid filtration. The quantity of charcoal to a given weight of sugar varies exceedingly. Where water is scarce or dear, coals

dear, and, above all, where the charcoal has to be sent out of town to be reburned, the quantity of char is necessarily reduced as far as possible, but in other circumstances the proportion should not be less than 25 cwt. of char to a ton of sugar. The size or "grist" of the charcoal must depend to some extent on the shape and size of the cisterns; but in all cases where it is possible to use it, a small size, such as would pass through a sieve of 20 meshes to the inch, but would be retained by one of 30 meshes, should be chosen. Theoretically, the smaller the grist the better, the finest dust being the best of all; but practically, the char must have a sufficient size to permit the liquor to pass through it in a reasonable time. Then as to the quality of the charcoal, it would occupy an entire lecture to go fully into that department. The whole subject is fully discussed in a lecture which I delivered last year in Glasgow, and which will be found in the Proceedings of the Philosophical Society of Glasgow (Vol. VI. part 4), also in abstract in the *Chemical News*. On the present occasion I can only refer to some points connected with this most important subject. Animal charcoal, when new, consists of carbon, calcic phosphate and carbonate, and minute quantities of some other substances; the composition is a little variable, but the following results of analysis of three varieties will convey a good idea of its usual constituents, A being made from ordinary bones, collected in this country; B, from South American shank bones, and C, from what are called camp bones, which are frequently buried for some years before they are collected :—

Dry.	A.	B.	C.
Carbon, nitrogenous	9·71	7·64	10·37
Calcic phosphate, &c. ..	80·48	84·05	78·70
Calcic carbonate........	8·82	7·61	8·05
Calcic sulphate	·34	·20	·53
Alkaline salts..........	·30	·25	·58
Ferric oxide	·12	·15	·21
Silicious matters	·23	·10	1·56
	100·00	100·00	100·00
Cubic feet per ton (dry)	51	49	47

The above analyses represent the charcoal as being dry, in order that they may be compared with one another; but practically the article is always sold with about 10 per cent. of water.

The so-called carbon in animal charcoal is not by any means pure, for it contains a very notable amount of nitrogen, and a small proportion of hydrogen, the quantities of both of these elements depending upon the degree of heat to which the charcoal has been exposed in the process of manufacture. Generally the quantity of nitrogen is about one-tenth part of the total carbonaceous matter, but sometimes I have found it considerably more. The proportion of hydrogen in well-burnt animal charcoal is exceedingly minute, being in one particular case (new) only ·034 per cent. Old charcoal which has been frequently used in refining, and reburned, contains less nitrogen, and the proportion appears continually to decrease. I have found it as low as ·3 per cent., and as the charcoal which gave this amount was not excessively old, I have no doubt it may be reduced even further. I believe that the nitrogen is an important and essential constituent of animal charcoal, and it is certain that no description of charcoal which does not contain an appreciable quantity of nitrogen is a good decolorizing agent. Wood charcoal, for instance, although eminently porous, and an excellent absorbent of gases, is a very poor decolorizing agent, and is practically useless. Red-hot animal charcoal quenched with water evolves ammonia, and I believe that the practice of cooling charcoal in this way pursued by some refiners is a highly injurious one.

New charcoal always contains traces of ammonia, but the amount is extremely minute, being in a particular case only ·011 per cent. The effect of this minute quantity, and of traces of sulphide of ammonium, is readily seen in the sugar run over new charcoal, which should never be used until after it has been well washed and reburned. New charcoal also contains invariably a minute quantity of sulphide of calcium, and gives off the odour of hydric sulphide when treated with an acid, and even when moistened with water. In a particular case a sample of new charcoal gave ·08 per cent. of hydric sulphide when treated with an acid. Char-

coal, both new and old, retains appreciable quantities of gases which escape when cisterns containing it are filled with liquor, and these gases frequently explode when a light is brought near the top of the cistern.

In a sugar-house the charcoal is usually burned every fourth or fifth day, and is thus reburned from seventy to ninety times in a year. Old charcoal has not the same chemical composition as new. The carbon almost invariably increases, and if the kilns are perfectly tight, ought to increase, so that the pores are gradually filled up with the deposit of carbon, arising from the carbonizing of the vegetable matter extracted from the raw sugar which it has been employed to purify. This deposit of carbon is a very great evil in sugar refining, and should be prevented, as far as possible, by washing the charcoal with boiling water before reburning. In some refineries the proportion of carbon does not increase, and in others it speedily diminishes, so that it sometimes does not exceed 2 or 3 per cent. When this decrease takes place, it arises either from the admission of air to the charcoal while hot, or from excessive burning, which causes a reaction to take place between the carbon and the elements of water, resulting in the formation of carbonic gas and marsh gas. But if the kilns and cooling boxes are tight, and the heat not excessive, the carbon will inevitably increase rapidly, unless we take the precaution of washing out of the charcoal, before reburning, nearly all the organic matters absorbed from the sugar liquor.

Extensive washing has also a most beneficial influence in removing mineral salts absorbed from the raw sugar. In all raw sugars a certain proportion of mineral salts is found, varying in ordinary cane sugars from $\frac{1}{2}$ to 1 per cent., in syrup sugars from 1 to 2 per cent., and in beet sugars, such as are used by the British refiners, from 1 to 7 per cent. The highly soluble salts, such as those of potassium, have no effect upon the charcoal, and only annoy the refiner by accumulating in the syrups; but calcic sulphate, a salt only slightly soluble in water, is readily absorbed by charcoal, and can only be removed by extensive washing. It is rather a singular fact, that so long as the sugar liquor is strong,

the sulphate is absorbed and retained; but whenever the washing begins, it comes away in the washings, so that it is no uncommon thing, in boiling down weak char washings, to obtain a plentiful crop, not of sugar, but of gypsum. When the water is hard, and contains much calcic sulphate, the proper washing of charcoal becomes almost, if not quite, an impossibility; and I have myself examined charcoal which contained 2½ per cent. of that compound. In beet factories where lime is freely used in clarifying the juice, the pores of the charcoal soon become choked with calcic carbonate, rendering it useless, unless the compound is removed by treatment with an acid.

But charcoal becomes old and useless from another cause; it gradually shrinks in volume, and the pores must become either lessened, or altogether obliterated. The space occupied by a ton of new charcoal, when dry, is usually about 50 cubic feet; but after being a few months in use it is reduced to 40, and so it goes on shrinking, until it reaches 28 cubic feet, which is the densest charcoal out of about 400 samples that I have tested. Now, this does not arise from an actual increase in the density of the charcoal. I have tried the specific gravity of old and new charcoal, and have found the difference very slight indeed. Thus, new charcoal, occupying 50·6 cubic feet per ton, had a gravity of 2·822, while the old, occupying only 35 cubic feet, had a gravity of 2·857. The fact is, that the heat to which the char is subjected produces a semi-fusion of the calcic phosphate, which is its most abundant constituent, and causes a shrinking in the bulk of the particles. The following simple experiment serves to illustrate this point:—A quantity of new charcoal, measuring 48 cubic feet per ton, was exposed, in a covered crucible, to a rather strong heat for an hour, after which it had contracted to 43·2 cubic feet, after two hours more to 40·8 cubic feet, after other four hours it measured 38, and with still four hours longer of a strong heat, 35·5 cubic feet—thus losing in eleven hours as much of its porousness as it would by being worked in a sugar-house for two years. It is well known to chemists that calcic phosphate is fusible at a high heat, but the temperature of a charcoal kiln is sufficient to produce only aggluti-

nation. New charcoal burnt white has the appearance of bits of chalk, but old charcoal has the texture of porcelain or flint. The quantity of liquid capable of being retained by the two kinds is also remarkable. If a funnel is filled with good new charcoal, perfectly dry, and water poured on it as long as it is retained, it will be found to hold in its pores from 80 to 100 per cent., while old charcoal retains from 30 to 45 per cent. according to its quality. Again, dry new charcoal does not become perceptibly wet, unless at least 20 per cent of water is added to it, while old charcoal is made wet with 5 per cent.

All these considerations point to the necessity of renewing the charcoal very frequently, in order that it may act efficiently. It is not enough merely to replace the dust that is sifted out occasionally, and to make up by the addition of new char for the shrinkage in volume that is constantly taking place. If proper work is to be done, and the charcoal maintained in a state of real efficiency, a portion of the entire char (not the dust only) should be set aside from time to time, and replaced by new material at the rate of 50 per cent. per annum, and the addition should be made constantly—one, two, or three bags of new charcoal in every cistern, according to its capacity.

As regards the proper quantity of charcoal to use, per ton of sugar, that depends a good deal upon the kind of sugar used, and upon the quality of the charcoal; but the smaller the quantity of charcoal the better, for the use of a large quantity entails a loss of sugar and the production of an extra proportion of weak and impure washings. For a ton of sugar 25 cwt. of charcoal is amply sufficient if the quality is good, and if fine sugars are used an equal weight is enough. It is a mistake to suppose that a large quantity of bad or exhausted charcoal will serve the same purpose as a moderate amount of good charcoal. Not only does it occupy more space, and so limit the production of refined sugar, but it does not, in any quantity, do the work so well, besides producing an overwhelming amount of "sweet water," or charcoal washings. I have found that it is impossible, on a practical scale, to wash out all the sugar from charcoal, so as to make the washings worth

boiling down, and that for every 100 parts of charcoal there is a loss of ·75 of sugar. If, therefore, an equal weight of charcoal is used, the loss of sugar will be ·75 per cent., while if two tons of charcoal are used for each ton of sugar, the loss will be 1½ per cent. from this source alone.

I have selected a few analyses of specimens of old or used charcoal, which will convey an idea of the variety to be found in different sugar-houses throughout the country.

	D.	E.	F.	G.	H.	I.	K.	L.	M.
Carbon, nitrogenous	9·74	10·60	12·86	19·64	7·42	10·64	5·82	17·28	2·56
Calcic phosphate ..	82·80	83·20	81·80	73·20	87·08	80·56	77·26	79·56	90·73
Calcic carbonate ..	5·92	4·15	2·92	3·18	1·92	4·52	14·66	1·05	3·50
Calcic sulphate	·67	·64	·42	1·12	·95	2·24	1·03	·59	1·10
Ferric oxide	·33	·55	·67	·66	·85	·72	·21	·69	1·17
Silicious matters ..	·54	·86	1·33	2·20	1·78	1·32	1·02	·83	·94
Cubic feet per ton..	44	39	36	32	29	35	40	34	35

D is first-class charcoal; E is of excellent quality; F is of fair average quality; G is pretty old and very much glazed; H is very old and overburned; I has been used in a sugar-house where hard water is employed; K has been used in a continental beet factory; L has been soured in the process of washing; and M has been exposed to the air while cooling.

The power which charcoal is capable of exerting in removing colouring matter from solutions is truly astonishing. A very good lecture-room experiment consists in pouring into a funnel, filled with good animal charcoal, an aqueous solution of cochineal, when it comes through perfectly colourless, and its presence in the charcoal in an unaltered form may be illustrated by boiling the charcoal with alcohol, when it gives up the colouring matter to that liquid. Port wine may be used for the same purpose, and with a like

result. Charcoal has also the power of absorbing vegetable albumin, gum, oxide of iron, calcic carbonate and hydrate, and calcic sulphate. In sugar we have vegetable albumin, extractive matters, and invariably some salt of calcium, and all these, as well as the colouring matter, are removed by the charcoal; and not only so, but their removal is important and essential, so that if we could practically bleach sugar by ozone, chlorine, sulphurous gas, or any other chemical agent, we should still require to use charcoal to purify the sugar.

The active ingredient in animal charcoal is unquestionably the nitrogenous carbon, for if the charcoal is burned perfectly white, not only on the outside of the grains, but to the very centre of each particle, it no longer retains the slightest trace of decolorizing power. But it is quite evident that the carbon owes its extraordinary powers to its extreme porosity, the carbon being infinitely comminuted and kept asunder by admixture with ten times its weight of calcic phosphate. The dark brown solution of raw sugar comes away at first perfectly colourless; after a time the pores of the charcoal begin to get saturated, and the liquor gradually becomes yellow, and even brown, if the process is continued long enough. The sugar refiner takes care to economize his charcoal by passing through it first a fine quality of raw sugar, afterwards an inferior sort, and lastly, syrups from the drainage of previous refines.

The calcic carbonate in charcoal is very useful in neutralizing the minute quantity of acid present in almost all raw sugars, and also the acids always formed during the washing of the charcoal by a process of fermentation which it is very difficult to prevent. Charcoal deprived of all, or nearly all, its calcic carbonate is very objectionable, and is sure to give rise to sour liquors and the occurrence of iron in the syrups. When the water used for dissolving the sugar and for washing the charcoal is very soft, the calcic carbonate gradually decreases, until, in pretty old char, it is reduced to 1½ per cent., and even in extreme cases disappears entirely. On the other hand, when very hard water is used, the calcic carbonate either decreases very slightly, or it increases, and

sometimes to an alarming extent; and in beet factories on the continent, where lime is freely added to the juice, the evil is a very serious one. In this case it closes up the pores, and many expedients have been adopted for the purpose of getting rid of it. This is done either by washing with 1 or 2 per cent. of hydrochloric acid diluted with a sufficient quantity of water to saturate the char, or better, by Mr. Beanes' process, which consists in impregnating the burnt charcoal with perfectly dry hydrochloric gas until it is saturated, then exposing it to the air until the excess of the gas escapes, and lastly, washing with water and burning. In beet factories, and, in some particular circumstances, in refineries also, when the liquors are slightly alkaline, the process is attended with the best results, but I have always objected to the use of acid in refineries using soft water, for there the calcic carbonate, instead of being in excess, is barely sufficient to neutralize the minute quantity of acid in the raw sugar. That animal charcoal treated with an acid gives a whiter liquor than it would otherwise do is easily demonstrated; but, on the other hand, it appears from my own experiments and those of others, that it is impossible to get rid, by mere washing, of every trace of acid; and the consequence to be feared is, that the sugar in the liquor will be, to some extent, converted into fruit sugar during the process of boiling down, that the char washings will be very sour, and the syrups contaminated with iron. In other words, I believe that in a refinery working under ordinary circumstances, less syrup is produced than would obtain if the charcoal were treated with hydrochloric acid, while in the latter case the colour of the sugar produced would be superior. It may be interesting to mention that while dry hydrochloric gas, passed over dry calcic carbonate, does not give rise to any action whatever, the dry gas passed over absolutely dry charcoal containing calcic carbonate determines the complete decomposition of the latter, especially if the charcoal is warm. Beanes' process, and others of a similar nature, may be applied with advantage to new charcoal for the purpose of bringing it at once into efficient working condition. New charcoal contains traces of ammonia and sulphide of ammonium, and also some free lime,

besides an excessive quantity of calcic carbonate; and although the ammonia is removed, and the free lime carbonated by the processes of washing and reburning, to which it ought always to be subjected before being employed in sugar refining, yet the excess of calcic carbonate makes the liquors very yellow, and it is usually five or six weeks before the charcoal is in first-rate condition. When, however, the new charcoal is added in small proportion to the old, there is no danger of any harm resulting, but, on the contrary, an immediate advantage is observed.

The oxidizing power of charcoal is well known to chemists, and although this property is useful in purifying water and in deodorising, yet in sugar refineries it is the cause of much mischief. When the char cisterns of a refinery are to be washed off, hot water is run on, while the heavier syrup descends, and is drawn off below. But the two liquids commingle to some extent, and a weak solution of sugar is formed which is exceedingly liable to fermentation. The free oxygen in the washing water, under the influence of the charcoal, appears to act upon the vegetable albumin which the charcoal has extracted from the sugar, converting it into a ferment which quickly changes the sugar into lactic acid, and this acid dissolves from the charcoal lime and traces of iron. The consequence is that the char washings are sour and putrid, and highly charged with salts of calcium, besides which they frequently smell perceptibly of hydric sulphide. The ordinary way of getting rid of these washings is to use them for dissolving fresh sugar, but no greater mistake in sugar refining than this could be made.

As regards the temperature best adapted for the action of charcoal on sugar, experience has shown that the liquor in the blow-up pans should be run off at 180° Faht., the char cisterns should have a temperature of about 155°, and never below 150°, and the water used for washing should be absolutely boiling. The quantity of water employed in the process of refining is, say for 100 tons of sugar, something like this:—for dissolving, 50 tons.; for washing to produce sweet washings to be afterwards boiled down or used for dissolving, 40 tons; for washing the charcoal to purify it further,

125 tons—in all, 215 tons, or nearly 50,000 gallons. I consider this the minimum quantity; an additional amount of washing is invariably attended with increased excellence in the quality of sugar turned out.

Revivifying of the Charcoal.

The reburning of charcoal, in order to restore to it the power of absorbing colouring matter and other impurities, is perhaps the most important process in sugar refining. The object to be attained is to carbonize the organic matter extracted from the raw sugar, so far as it has not been removed by washing. The process should be economical as regards fuel; it should allow of the complete carbonization of the organic matters; it should permit of the ready escape of the gases and vapours produced; and it should expose the charcoal for only the smallest possible length of time to the heat required for carbonization, so as to avoid the contraction of the pores of the charcoal, besides other evils that result from overburning. There are two distinct kinds of reburners: those in which upright pipes are used, and those which consist of horizontal revolving cylinders.

The kiln in general use consists of a series of upright cast-iron pipes, arranged in six rows of about ten pipes each row, three rows being placed on each side of the furnace. The flame of the furnace plays directly upon the pipes, and the products of combustion are conducted away from the sides of the kiln. The wet char, as it comes from the cisterns, is placed upon the top of the kiln, and sinks gradually down as the burnt char in the pipes is allowed to fall into the cooling boxes below. These consist of sheet-iron vessels, the same length as the row of pipes to which they are attached, about six or eight feet deep, and an inch or three-quarters of an inch wide, and cooled simply by contact with the atmosphere. The cooled charcoal is drawn from the cooling boxes every twenty minutes, in such proportion that it is about six or eight hours in the pipes altogether. The time given should depend upon the heat of the kilns, and different quantities should be drawn from each row of pipes according to the amount of heat they receive

from the fire. Thus, if there are three rows of pipes, the one nearest the fire should be emptied in about 5 hours, that in the middle in 7½ hours, and the back row in 10 hours. These kilns, although tolerably economical as regards fuel, are open to many objections, not the least of which is that the wet charcoal above prevents the free escape of the gases and vapour evolved from the carbonizing and drying charcoal. Of the heat consumed in the kiln, four-fifths are absorbed in drying, and it is a great mistake not to dry the charcoal, wholly or partially, before putting it into the kilns. I cannot occupy more time with further details of the various mechanical arrangements which have been adopted by various sugar refiners, nor with the description of the various forms of revolving cylinder-kilns, information about which will be found in my paper on charcoal, previously referred to.

When the charcoal is sufficiently cold, it is again placed in the cisterns, and the whole process is repeated.

EVAPORATION OF THE LIQUOR.

The next process in sugar refining is the boiling down of the decolorized liquor, so as to recover the sugar in a crystalline form. This, as is well known, is effected by means of a vacuum pan, in which the vapour that is formed is condensed by jets of water, and the vacuum is maintained by means of an air-pump. A pan of good size is 10 or 12 feet in diameter, and may hold about 20 tons of sugar and syrup. The boiling down occupies usually about two or three hours; the extent of vacuum averages, in a well-made pan, about 28 inches, and the temperature is usually 120° Faht. at the beginning of the boiling, and about 130° at the end of the process. The improvements introduced of late years into the vacuum pan consist in increasing the extent of heating surface, and the quantity of water injected into the condenser, and in enlarging the neck of the pan to 18 inches, or even more, so as to permit of the free escape of the vapour into the condenser. The operation commences by running into the pan a quantity of liquor sufficient to cover the first coil of steam pipe or "worm," when the steam is turned on and the boiling commences. After a time

more liquor is run in, and so on, a little at a time, until the pan is full, the different tiers of worm being supplied with steam as soon as they are covered. At the very first the liquor is boiled strong enough to form a "grain," consisting of almost microscopic crystals of sugar, and these increase in size as the boiling proceeds, until at the finish they are as large as may be desired. It requires a considerable amount of training and skill to boil sugar so that the grain may be gradually built up. What is called false grain consists of a mass of minute crystals collected into grains, and although in some cases this kind of compound crystal results from the carelessness or want of skill of the boiler; in other instances it is made intentionally, so as to give the resulting sugar a whiter appearance, and to enable it to hold more syrup.

When very large and distinct crystals are desired, such as are made in Bristol and Glasgow, a modified arrangement is adopted. The liquor is boiled more slowly and at a higher temperature, and when the pan is full the whole contents are not drawn off, but only a half; and this is repeated several times, the crystals becoming larger every time. The large crystals are much prized on account of their beauty and purity, but they have the disadvantage of being troublesome to dissolve, while the manufacture of them necessitates the exposure of the syrup with which they are mixed for a long time to a rather high temperature (about 160°), causing the conversion of a considerable portion of sugar into the uncrystallizable form, and also darkening the colour of the syrup. And here I would give a word of advice to refiners, who all insist that in order to obtain large crystals a high temperature must necessarily be employed. I believe this to be a mistake. If sugar requires a high temperature to form large crystals, it must be different from all other crystalline bodies; and besides, sugar candy is formed at a low degree of heat, and consists of larger and more distinct crystals than ever were formed in a vacuum pan. Large crystals must be formed slowly, and the degree of heat is, I believe, a matter of indifference. Strange to say, I have not succeeded in inducing any refiner to boil slowly and at a low temperature. They all say that it cannot be done, and so the matter rests. The mistake they

make is, that they regulate the rapidity of boiling, not by the quantity of steam admitted to the worm, but by the quantity of injection water, so that, when the latter is diminished, the extent of vacuum is lessened, and the temperature necessarily rises, while the steam, not escaping readily, retards the process of evaporation. If, on the other hand, the maximum quantity of injection water were maintained, and the amount of steam diminished, the boiling would be as slow as might be desired, while the loss to the refiner by exposing the syrup to a high temperature would be avoided.

In boiling down the syrup obtained from the drainage of the first crop of crystals, less care is required, a small grain being preferred on account of carrying more syrup than a larger grain. In boiling the lowest grade of syrup it is customary to make what is technically called a "jelly;" in other words, the formation of grain is entirely avoided, and the result is left for several days in tanks, in order that crystals may form. There are generally three qualities of crushed sugar made, viz., whites, mediums, and yellows, the whites constituting nearly half of the entire produce; but the proportions of the different kinds vary to some extent with the kind of raw sugar employed. The total produce of 100 tons of raw sugar should not be less than 95 tons.

The separation of the crystals from the syrup with which they are mixed is effected in an apparatus called a centrifugal machine, which is simply a perforated basket revolving at great speed, so that the periphery travels at something like 100 miles an hour. The drainage of the crystals occupies from three to twenty minutes, according to quality; and in the case of the finest and whitest variety, a dash of cold water is sometimes given in order to wash off the adhering syrup.

And now I must bring my lecture to a close, and have to thank you for the kind attention you have given to the subject. I feel that I owe some apology to the scientific chemists present, who must have listened, I fear, with impatience to details in which they can have felt little interest. I have endeavoured to avoid mechanical details as far as possible, while trying at the same time to exhibit a connected view of the whole process; and to the sugar

refiners who have favoured me with their presence I have to say, that it is impossible in a single lecture to give anything like a complete description of all the improvements that have during the last few years been introduced, much less to describe the results of the investigations connected with this branch of industry with which I have been engaged. The field of inquiry is one that is sure to be fruitful of valuable results to any careful observer, and I trust that my few remarks, if not otherwise useful, may at least have the effect of attracting attention to a subject of great importance.

ROUGH NOTES TAKEN ON A FLYING VISIT TO THE NORTHERN DISTRICT OF BRITISH HONDURAS.

The whole of the northern district is nearly a dead flat, save a few small hillocks or ridges, and some shallow basins with a very gentle incline from the frontier to the sea, giving a slight undulation to a plain of about one thousand square miles, covered with the valuable native forest trees and the rank vegetation peculiar to the Tropics, excepting the patches of cultivation, here and there, where the plantations and ranchos are established, and a few sugar heads begin to raise their heads.

There are several lagoons, and comparatively few swamps and marshes, with abundance of logwood and mahogany. The soil is a vegetable mould, a thin layer of decayed vegetable matter, *humus*, of some 12 to 18 inches, deposited on a thick sub-stratum of decomposed limestone, formed into a hard compact mass of white calcareous marl, which may be cut into blocks or burnt into a carbonate for building purposes; but as there is no gravel or sand, these would have to be procured elsewhere on the coast to form mortar.

This surface soil, being a rich black mould, is well adapted to the sugar cane and other tropical plants. It is thinly scattered

over the stony marl, to the depth, in some localities, of only 3 inches, increasing in thickness as you penetrate inland, while, in some places, the ground is bare, and the hard white marl crops out and renders the spots barren and unfit for cultivation.

In the sinking of wells at Corosal, madrepores have been found at a depth of 30 feet, and recently, at Caledonia, a bed of fossil oysters was discovered 17 feet below the surface. The water is brackish, dark and fetid at first, but soon becomes fit for common purposes, but hardly ever to drink.

In the rainy season the ground becomes sticky and adhesive (viscous), very trying to man and beast; but in the dry it does not cake up, and crack, and burn like clay, but becomes friable and crumbles into a fine powder, which the very heavy dews at night keep moist and fresh. Hence it is, perhaps, that the canes might ratoon so long as they are said to do. But still I doubt if they could do so beyond a limited period without fallowing or manure, or returning to the soil what may have been abstracted by the produce. The practice of burning off the fields must destroy the roots of the canes and what there is of the soluble salts and volatile organic matters, substituting too much potash, and I fear a long drought would almost ruin the estates.

I have seen canes planted when the first plantations were opened up five or six years ago, still in a passably good condition, but small, with short joints, and far inferior to some in the West India Islands, their worn-out and exhausted soils notwithstanding. And I was shown a field said to be 20 years ratoons (!) without manure, the canes of which, though very poor, produced a fair quantum of sugar. As a rule, the plants are not so luxuriant, and the canes not so large and succulent as those of the southern district; but they appear to contain more saccharine matter in proportion. I have been assured that canes planted at the time of the Bucalar exodus, some 20 years ago, have been ratooning ever since, never supplied or manured, very sparingly cleaned by cutting down the brushwood between, with the macheat, the hoe being seldom used, except in planting, and the plough is unknown, perhaps not as yet required.

The uplands are so far in the interior that very little of their débris can reach these parts; hence the superficial soil is composed principally of the decayed droppings of the forest, whereas, in the southern district, where the hills are nearer the coast and the irrigation greater, from the numerous streams that cross the country, the surface soil is alluvial—a thick loam formed of the silt and disintegrated matter of those hills.

It appears to me that a line drawn from the mouth of the Belize River to Indian Church (where I am told the limestone crops out in blocks like marble) on the one side, and another along the Rio Hondo on the other (on the north bank of which, the Yucatan side, the highlands commence), would embrace a region, the formation of which consists of this thin surface soil, super-posited on the indurated marl; while on the south of the first line the base is a true limestone, with a thick covering of loamy clay, in some places 5 to 6 feet deep. But I am told that to the west of the pine ridges about Booth's River, the Bravo, Blue Creek, &c., the marl is over-topped by a thick stratum of blue clay under the surface soil.

I fix the first line on the River Belize because, from the many creeks that join it, and from the conformation of the country, the greater part of the washings is brought down on that side, and at the floodings the land is submerged and the detritus spread over a large surface, whereas comparatively little goes to the north, from the want of current in the New River, and the comparative paucity of irrigation there.

In the neighbourhood of the Sarstoon, and beyond, the sub-soil is a ferruginous sandstone, and the surface is mixed with quartz pebbles, mica, iron oxide, comminuted volcanic ejecta, and the remains of other primitive rocks, disintegrated from the mountains in the immediate vicinity; and I suspect that in the course of time, as the country becomes more explored and better developed, gold-bearing quartz and other precious metals and minerals will be found.

Corosal, the principal town in the northern district, and the oldest settled village in the colony, occupies an area of about half a

square mile, and is situated on the coast, upon the dome of a cavernous formation, indicated by the hollow sound of horses' hoofs as they gallop along the streets; and on examining the ledges on the sea-shore, the old rotten crumbling coralline deposits are seen decayed and decaying, porous and honey-combed throughout. Indeed, it seems that a range of reefs originally extended all the way to Ambergris Island (for the banks of Consejo, Rowley's Bight, Rocky Point, and Bulk Head, &c., correspond exactly with those on the opposite side), and being hollow and worn in the manner peculiar to some of the tertiary limestone formations, must have caved in, crumbled and sunk, from some internal convulsion; and the sea rushing in, formed the Bay of Chetumal, and the débris, commingling with the waters, produced that thick sediment of white clayey marl on the bottom in which no fish can live, and to which the Hondo and the other rivers are continually adding, as they flow through channels of the same calcareous nature, imparting to the water a milk white colour.

There are about 500 houses in Corosal, built generally in the rude native style, with no flooring, with thatched roofs, and sides stockaded and plastered with clay and whitewash; but several of two stories have been lately erected of stone and wood, boarded and floored and arranged in regular order; there is a Methodist chapel and a fine large Roman Catholic church, the latter built of stone, with a roomy residence for the priest in the courtyard behind, and the streets are laid out at right angles, with a neat little square or plaza in the centre, so that the little township presents a cheerful, healthy, and civilized appearance.

There are several schools, well attended, in which the elements of education are taught, and the English and Spanish languages simultaneously cultivated with success.

About six years ago, when I first visited the place, the street fronting the sea was a fine wide alameda, but now the water has encroached very much, in some places as much as 10 feet, so that the street is considerably narrowed, and unless banked up, the sea will, in course of time, reach the threshold of the houses and undermine them altogether.

The population of Corosal proper is about 2,000, chiefly Indians and Spanish creoles, natives of Yucatan and Guatemala, with a few shopkeepers from Belize; but the whole estate, about 60 square miles, contains about three to four thousand souls. The fee simple is in Mr. John Carmichael, who rents out a considerable portion of the land, and receives an income of about 10,000 dollars per annum.

The place is dotted over with several little plantations called "ranchos" and "milpas," 10, 20, to 100 acres in extent, where, besides the sugar cane, plantains, corn, rice, and other provisions are grown, and sugar and rum manufactured in a primitive way, with small alembics, rudely constructed, and wooden mills worked by cattle; but the produce is of excellent quality, and the cultivation realizes a remunerative price at the Belize market. They carry on their operations at a comparatively low expenditure, as their labourers are chiefly their own countrymen (native Indians), who are content with but little pay and no rations.

Mr. Carmichael himself has two or three sugar estates, one with the appliances of steam; but he has sold out one or two to some of the American immigrants lately settled there.

He is now settled on San Andres estate, the first spot settled upon by the Spaniards at the exode from Bucalar about 20 years ago, and where sugar was first made in this colony, and where it is still made from canes said to have been planted at that time and ratooning ever since, without manure and without culture, save such as is peculiar to the rough system of the native; but, from the plan he has lately adopted, the estate has improved wonderfully. The canes look well, though I cannot compliment him on the tillage. The grass and brushwood are still permitted to grow up with the cane, and are not destroyed till after crop, when the fields are burnt off and the stumps and germs allowed to sprout again, and weeds, and bush, and cane grow up together till next crop, very little weeding being performed in the meantime.

The canes, like on all other estates, are planted too near (6 feet apart is the usual distance in the Islands), and not deep enough. The subsoil should be turned up by deep ploughing and holing, so

that the roots of the cane might penetrate the marl, which, however forbidding in look, when crumbled and mixed with sufficient vegetable soil, affords abundant nourishment to the cane.

All planters know that the root of the cane has a tendency to grow out of the soil, and when the plant has but a thin covering, the rains soon wash that away and leave the plant exposed to the scorching rays of the sun. Add to this the annual burning off of the fields, and one can easily guess how long a piece would ratoon.

Besides, when planted closely together, the leaves soon intertwine and mingle, and the field becomes impenetrable, leaving no room for the passage of air, or the necessary weeding and banking during the progress of growth. A fair distance gives large stools and full succulent canes; too close furnishes numerous little reeds with no substance, choking one another, and struggling for the tittle of nourishment to be divided amongst so many sprouts.

There is also too great a waste of megass on all the estates. In a country like this, where wood is so abundant and near at hand, it should be used as fuel instead of megass, which, together with the cane tops, should be returned to the soil, green, so as to compensate for the substances withdrawn in the sugar. The great principle in agriculture is to return to the soil in one way or another, by manure, green bush, top dressing, alternate crops, fallowing, &c., as much as possible of the matter abstracted by the cultivation, and where this is neglected, the richest soil soon becomes exhausted and the estate goes to grief; still, San Andres has already made 50 casks (about 40 tons), and expects to make at least 100 more, on a cultivation of 100 acres; and as the proprietor is an energetic, persevering, old gentleman, I have no doubt that he will eventually effect a great change, and end in established success—a destiny I most sincerely wish he may soon accomplish.

Caledonia is one of the largest and best laid out estates in the quarter. Messrs. Kindred & Phillips have spared no expense in fitting it up. They have imported one of Fletcher's largest engines, capable of producing 10 tons a day, and the works are erected on a solid foundation and on regular scientific principles, with all the

appliances and modern improvements, coming up to the best I have seen in any of the Islands, and similar, I understand, to the one now being erected by Messrs. Young, Toledo, and Co., at Seven Hills. It has three clarifiers and two taches, with the usual battery of three coppers (called here "kettles"), but the engine can well supply a double set. With less than 500 acres in canes, and 100 mules and 100 head of oxen, the estate, in my opinion, cannot be profitably worked. The proprietors, however, I understand, do not contemplate any further improvements (save extending the cultivation) till they are satisfied as to the success of the Concretor principle.

They have about 250 acres in canes at present, but only about half can be made available this crop, some of which are two year ratoons and stand overs, and do not yield very much just now; but the next two or three months are the best yielding season, when doubtless the juice will improve. The rest are young plants, clean and healthy, and coming on luxuriantly. They have 30 tierces on the stanchions, and I calculate they ought to make 150 tons this year. The number of gallons of juice to the ton of sugar ranges from 1,500 to 3,000, and the density per Baumé is from 10° to 13°.

The planters all make a larger estimate of the produce of their fields, but I am not aware that any estate has ever realised an average of more than two tons the acre. In fact, the experiment has never been tried on an extensive scale, and for the simple reason that there has never been (and there is not yet) an estate proper, regularly established long enough to have fairly tried it on.

On some detached pieces or isolated patches, where the soil is deeper than usual, a larger proportion may doubtless have been obtained, but I question whether three and four tons per acre should be taken as a general estimate throughout. At the same time I must in candour and fairness say, that in the face of the Rancheros' system of cultivation, or rather want of system, the fact of their being able to work their own little plantations at a fair profit, notwithstanding their negligence of the cane from its first sprouting to its maturity, and the other fact of many of the larger fields ratooning for several years without scientific culture

and continuing to produce an extraordinary yield, show the marvellous fertility of the soil; and that in spite of the lightness of the upper strata, there must be some properties in it peculiarly adapted to the growth and sustenance of the plant. This anomaly of the long duration and extraordinary yield of the cane here is so often reiterated by every planter, that one becomes at last almost reconciled to the apparent paradox.

They are still levelling down the forests, clearing out land, and opening up roads at Caledonia, but it requires a large capital to carry out these tentative operations, and some years must elapse before a good return on the outlay can begin to flow in; for in the first year only half of the cleared land can be planted, the other half being occupied by the dead stumps. In the second year they may have rotted or to be easier rooted out, so that it is only in the third year after felling that one can look for a fair return out of a given area planted; and even then another year must pass before the maximum yield can be expected, for plant canes seldom produce so much sugar as first and second ratoons well cared for, and it is only then that the cane arrives at full yielding condition. Where then is the estate here of which it can be said this result has been fully realized?

There is a growing village at the Barcadier at Caledonia, by the river-bank, which at present contains about 40 huts, where the labourers and some independent settlers are located, and a little retail shop supplies many necessaries from Belize, which is a great convenience to the people. Besides this, some 20 new huts have been erected nearer the works for future hands, and a tramway is about to be constructed from the works to the shipping place, so that, upon the whole, the future prospects of the property are very hopeful and encouraging.

The other estates in the quarter are on a smaller scale than Caledonia, with inferior engines and machinery. I did not visit them all, but I understand that they are all more or less on a par. On those I visited the canes are mostly old ratoons and stand overs, and the fields appear neglected if not exhausted, and some of them require new land to be opened up, excepting Tower Hill and Indian

Church, which I understand are in a very flourishing condition. Large improvements are being made on all of them, in the works and in the fields, by the American planters lately arrived, and I am told most excellent sugar, purified with sulphur, is made at Tower Hill by Mr. Price, the manager, from Louisiana; but this description of sugar does not keep, as it soon becomes infected with vermin.

Indian Church is the crack estate of the quarter, and more extensively cultivated than any. I regret that time did not permit me to reach that length, as it is said that the soil is deeper and richer than in other parts, the geological features more fully developed, and the scenery around more picturesque; the canes of enormous size, larger than those in the south and yielding abundantly. A large engine is being erected with powerful machinery, &c., on a new principle, with all the appliances and modern improvements, and a Concretor is about to be added and several scientific operations commenced. The British Honduras Company were the first, I believe, to take the initiative and attempt to lead the industry of the country to agricultural pursuits, and they have been at vast expense to promote the success of sugar making; and although they have had great difficulties to contend with, and have met with many disappointments, their enterprise has not slackened, and they are still persevering in their efforts and continuing in the race of progress, and, I hope, prosperity.

It appears to be the rule not to weed or trouble the canes once they are cut, for almost every field that I saw was unweeded and choked up with weeds, and yet they make sugar. Every planter knows that unless the canes are weeded two or three times while sprouting, till they overshadow the ground before the weeds spring up, it will be impossible to go through them with the hoe after they are grown up; but here they do not seem to know the pithy proverb of the windward and leeward islands, that—

"The sugar is made in the field,
"The boiling house shows but the yield,
"And there, as your canes are kept clean,
"So here's the effect fully seen."

But, indeed, there are very few really energetic practical men in in the colony acquainted with the routine of tropical plantership; and no regular system of cultivation is adopted, all, with very few exceptions indeed, are as yet mere theorists and experimentalists, groping in the dark, and it is only surprising that they have hitherto got on so well.

All the estates have huts ready built for the labourers, where they appear comfortable enough, but the women do not work in the fields or attend the mill and megass as in the islands; they remain at home to cook their husbands' meals and attend to other domestic avocations.

The sugar is of a rather dark colour, (except what is made expressly for local consumption) though of good grain; but I believe this is done to order, as it is found that the difference in the price of the finer sorts in the home markets is not equivalent to the difference in the duty.

Orange Walk is the next village of importance in the district. It is situated about 30 miles from Corosal, on a little rising ground on the right bank of the river going up, from which a fine view of the country round can be obtained. The lots are not, as at Corosal, rented out to parties, but are mostly the freeholds of the occupants. They are all railed in, and have their outhouses and little kitchen and flower gardens, their poultry yard, "corals" and "patios," cosily and neatly arrainged within, which give the whole a very lively and animated appearance. While the troops were there a considerable amount of business was done, but the place suffered very much from the fire of the last two years, and is now but slowly recovering from the shock. There are about 200 houses, amongst them several gay little shops, with a good variety of articles from Belize, and the population numbers at present about 800 souls, consisting principally of logwood cutters, rancheros, and labourers on the neighbouring estates.

San Esteban is a neat little village on the left bank going up, midway between Caledonia and Orange Walk. Don Florencio Vega is the proprietor, who receives about 2000 dols. rental from the occupiers. It contains about 200 houses and 1000 souls, chiefly

logwood cutters and builders of bungays and other small craft. A great quantity of corn, plantains, pigs, poultry, &c., used to be produced here and at Orange Walk for the supply of the district as well as Belize, but it is not in a very flourishing condition just now.

There are other villages and little settlements about with small clusters of population, such as Xaibe, Consejo, Sartaneja, Rocky Point, &c., but I had not time to visit them.

The roads about are wide and good, intersecting the country in various directions, and affording easy intercommunication and pleasant riding to the different estates and ranchos, but the New River is the principal highway for travellers up country. It runs from above the lagoon at Indian Church, down to the bight in Corosal bay, some 100 miles, navigable all the way for small craft, and the estates are conveniently situated in the vicinity of the banks for the shipment of their produce.

It is a dull sluggish stream, with no rapids and little or no current, and it seldom or never overflows its banks, as all the backwater flows through black creek into the Belize river. Hence the want of alluvium on *this* side, and the superabundance on *that*. Besides this, there are only the northern river and fresh water creek to irrigate the land, and these are comparatively small streams, but there seems to be no lack of moisture, and the water is not fresh but brackish, and hardly drinkable even up to Indian Church.

The navigation is tedious and monotonous, as it is a poling all the way in bungays, or paddling in canoes amongst bush and jungle and along a swampy margin till one gets up to the source. But, San Esteban is a sort of half-way house, and I was agreeably surprised when I landed there on the 10th of February, to find the people in the midst of this wilderness celebrating this carnival. The men neatly dressed, and the women, some very pretty Indian girls amongst them, in a peculiar national costume, decorated and adorned with many gold chains and brilliant jewels in a very tasty manner, gracefully dancing and enjoying themselves on the open lawn—thus presenting an agreeable contrast to the sameness of the scene we had just passed through.

There are several artificial mounds, cairns, or tumuli in different places, built up of the native marlstone, the uses of which remains a mystery to this day. They appear to have served as a sort of watch towers or beacons to the aboriginal inhabitants, but no one can now tell the exact purpose for which they were constructed.

At Caledonia in particular is a range of seven, disposed in a sort of crescent along the banks of the river, which seem to have subserved the purpose of a fortification at the entrance of a town or city. Many blocks of the stone that have been dug up shew evident marks of art and skilled workmanship, and some people think they must have been used as mausoleums for the dead, but one or two that have been excavated have not confirmed the supposition. Several little images were found, some of baked clay, shewing great ingenuity, and some carved out of the native stone, in excellent preservation, their delicate chiselings proving that the artists, whosoever they were, had attained to considerable perfection in sculpture.

At Corosal are many large ones scattered about, several of which I inspected on a former occasion. One was about 60 feet high, with a large circular base tapering at top like a truncated cone or pyramid; and another about 100 feet square, bearing north and south, divided into several compartments of different dimensions, evidently a sort of palace or temple, with reception hall, chambers, and anti-chambers, &c., all ruinate and crumbling into dust. The mystery of these buildings I apprehend will never be cleared up.

Many of the inhabitants who quitted at the time of the Indian panic are now gradually returning, and the people all appear lively, industrious and thrifty; and this being crop-time, and the estates in full operation, the labourers are fully occupied, cheerful and happy, and seem to have no more fear of Indian raids or any other bug-bear. They are, however, a little awkward at their new employments, and somewhat disorganised, or rather, I should say, not yet properly organised to plantation work, but this was to be expected in the infancy of a new regime, and I have no doubt that with good management and care, and proper temper and tact, they will eventually be induced to take to their new vocation *con amore*.

There is an Indian custom, a great festival, annually held here, called the "Xaibe Fiesta," which tends in no small degree to demoralize the labouring population. In the first week in the month of May, when the southern cross is on the meridian about midnight, the Indians, accompanied by the other labourers from all parts of the district, and patronised by the gentry, assemble at the village of Xaibe to celebrate the feast for a week, with dancing, drinking, and gambling, and all sorts of licentious dissipation. The square in the centre of the village, where, by the way, there is a Roman Catholic Chapel, is crowded with little booths and tables, on which liquors are exposed for sale, and gaming with cards and dice is carried on night and day. The first day is devoted to the Indians proper, when a number of women called "Mestizas," in gawdy, fantastic dresses, their hair decorated with long streamers of bright coloured ribbon, and their persons with a profusion of gold ornaments, bracelets, chains, amulets, &c., assemble in a large barn open at the sides, and built expressly for the purpose, and commence dancing to a dull monotonous air, with the men of their tribe called, "Vaqueros," who take them out singly, one after the other, and perform a sort of war dance, in a tame, lifeless, unimpassioned manner, apparently, however, very significant and full of meaning to themselves; the men making sundry genuflexions, gestures, and gyrations, by no means very intelligible, till they have gone through the whole circle of attending women. These, without grace or elegance in their movements, their dull stolid faces and vacant empty gaze, expressive neither of animation or enjoyment, hop about, listlessly, like so many automata; while a great concourse of the gentle and simple crowd around to look on.

It is the practice to select a stranger, and, *nolens volens*, powerless to decline the honour, elect him master of the feast. He is then taken to another part of the square, placed in a litter made of twigs and branches, and carried on the shoulders of four men, who, preceded by a band of music and followed by a crowd, march in triumphant procession all round the square, and then take him into the barn and place him in a chair at one end of the room. The fairest lady of the company, previously decided upon, is then chosen

and placed beside him as his consort. He is then said to represent a great lord of the manor or casique presiding over the amusements of his subjects. There he sits for hours, with no very comfortable feelings, undergoing a sort of penance, looking at the dancers, and inwardly reflecting on the degradation to which the selfish policy of man may reduce his species. After the dance is over he calls up the women one by one, compliments them on their performance and their good behaviour during the past year, and pays them off their wages in hard cash. Heretofore, this used to be in dollars, but latterly, from one shilling to half a crown is the range, according to the liberality of his lordship's temperament, and which in the end amounts to a good round sum; so that, eventually, the temporary casique finds he has been most woefully sold, and has had to pay dearly for his involuntary honours.

After this, he and his consort retire to enjoy a sumptuous dejeuner, prepared in another building, leaving the Indians to indulge, to their heart's content, in a liberal supply of corn cakes, tortillas, and catamalas, and revel in exciting libations to their traditional gods and heroes.

In the evening the gentry and visitors take their turn, and commence dancing to music of a more civilized and intelligent sort, performed by the same professors, who, to do them justice, acquit themselves very creditably on violins, pipes, and brass instruments.

The next night the same orgies are repeated, (except that part appropriate to the Indians) all the company mixing together promiscuously, and having a jolly bout of it till the peep of day. This is continued day and night during the whole week, accompanied with gambling, discharging of guns, display of fireworks, &c., the employers taking it by turns to defray the expense, and contributing, by their presence and participation, to encourage and perpetuate this ruinous custom, a relict of the superstitious rites and ceremonies of a barbarous age. To the credit of the people be it said that rows and shindies seldom occur. The Indian drinks his fill and quietly lays him down to sleep out his debauch.

The consequence of all this is, that for the next fortnight no work is done. The labourers take the first week to rest themselves

and recover from the effects of their dissipation, and in the second week they resort to their milpas, to prepare their grounds for the planting season, now fast approaching; while the master, anxious to take in the rest of his produce before the rains set in, is left to finish his operations as best he may, and sometimes the wet overtakes him with a great part of his canes still in the ground, which he is thus compelled to leave as stand overs for another year, to his great detriment and loss; and thus hundreds of pounds are yearly sacrificed to the shade of a savage custom which injures the interests of the employer, corrupts the morals of the people, and promotes a degree of vice and depravity, that has become a public scandal, to tolerate which is a disgrace and a reproach to a civilized community.

The planters are all aware of the evil tendency of this odious sarturnalia, and say, in self defence, that they are obliged to connive at it in order to keep their people in good humour, and induce them to remain in their service; but, however much this necessity might have been felt in the infancy of the colony, when the staple of the country was mahogany and logwood, which required no continuous labour save at one season of the year; now that attention is to be turned to agriculture, and especially to the cultivation of the cane and the manufacture of sugar, which, more than any other species of industry, require constant application and uninterrupted labour; to submit to such a sacrifice at the shrine of Bacchus, and countenance and encourage a usage whose advent occurs at a critical time, in the midst of crop, when the utmost energy and exertion are required to reap the reward of all the planter's previous toil—is a suicidal policy that must subvert his best interests, and entail ruin in the end.

Why not unite to abolish it altogether, or substitute another season, either during the Christmas holidays or after crop, as a sort of harvest home, to celebrate these revelries; gradually divesting them of their heathenish accompaniments, till time shall eventually wipe off the recollection of those ancient traditions, and connect the festivities with more modern and enlightened associations, and thus, imperceptibly, wean over the Indian to the change?

The bull fights that used to be the *sine qua non* of these revels have been suddenly abolished, and I see no reason why the Bacchanalian accessories may not also be finally exterminated.

(To be continued.)

SUGAR, GLUCOSE, AND SACCHARIMETRY.

BY M. DUBRUNFAUT.

(*Continued from page* 213.)

THUS, if we take a given weight of inverted sugar and transform it by means of the sodic or potassic reaction, as is done in our method of alkaline saccharimetry, this product will no longer act upon the copper; but if this transformation has been accomplished by means of lime, as often happens in the refinery and sugar factory, the glucose will still be able to reduce the oxide of copper to a certain extent; nevertheless, there will be this difference, that the glucose which before the action by lime would have indicated two per cent., will now indicate only one. We may then conclude from this that the action of inverted sugar has different exponents before and after the treatment by lime, and that these two exponents bear the proportion of two to one.*

Thus, we may understand that in applying the test to products which contain glucose transformed into calcic salts by the lime, these salts may yet act in the same manner as glucose itself. We have seen molasses which, affected by this cause have indicated on analysis 10 per cent. of glucose, when in fact it contained only 2 per cent.; and as the molasses was intended for the distillery where glucose is accounted as sugar, the error committed was entirely to the prejudice of the buyer.

In sugar a similar error would be to the prejudice of the seller

* The state of our investigations into this kind of reactions is not sufficiently advanced to enable us to draw up definitely a precise statement of facts. We confine ourselves to pointing out some of these in a summary manner, intending to revert again to the question before long.

if the correction of the glucose co-efficient was applied to it. Our alkaline method applied in these conditions does not correct the error which we have noted; in fact, the derivatives of glucose produced by lime give the same indications as glucose in the alkaline test.

It is to avoid these causes of error that we have indicated the following modification of our alkaline saccharimetrical method.

Instead of destroying the glucose by standardised alkaline liquid, sodic or potassic, we destroy it by a standardised solution of sucrate of lime of sufficient strength exactly to neutralize the sulphuric liquid of Gay-Lussac.

The amount of lime which disappears by heating glucose to the boiling point corresponds very nearly to 1½ equivalents, as with the sodic liquid, and thus the proportion of glucose may be estimated with some degree of certainty and with approximate correctness.

At the same time it must be remembered that this process is not so sensitive as the copper test, and that it cannot be applied to minute proportions of glucose; but it compensates for this imperfection by removing the chances of error which we have noted. It is, in fact, by this means that we have been able to prove that a molasses which under the copper test indicated 10 per cent. of glucose, in reality only contained 2 per cent.

At all events this method, well managed, will be a useful means of verifying other processes. Thus, with the copper test applied in the search for glucose, if the presence of calcic derivatives showing as glucose is suspected, it may be recognised by the sucrate of lime process, which will separate the two products; by using the sodic method, we should transform the glucose and its calcic derivatives into products which are in no degree affected by the copper or lime tests.

Here, then, we have a collection of processes valuable as capable of determining the presence of glucose in the products of our sugar factories. They may in addition furnish other useful indications, and make known for example whether the glucose is produced during the process of manufacture.

Generally the salts of lime which are found in the residual molasses are produced from transformed glucose, which has given birth to the derived acids; and as these acids are indicated by the copper and sodic tests, it is always possible by the use of these means, in the way we have pointed out, to determine (as far as regards the glucose impurity) the true value of the processes which have been employed in the manufacture.

It is by the use of methods of this kind applied to molasses that we have been able, by a knowledge of the cause, to form a judgment on the errors of the new methods of manufacture, on the faults of the sugars sold to the refiners, and, in short, on the evils which these products introduce into the operation of the refineries.

We do not yet know the exact value of the co-efficient which should be equitably applied to the glucose previously existing in the sugars of commerce. It has been proposed to deduct from the saccharimetiical value, once or twice the weight of the glucose found, and although these corrections may be the most frequently too small, yet it will protect the sellers, who believe themselves already great losers by the application of the co-efficient five applied to the salts.

Upon this delicate point, it is our duty to pronounce our unreserved opinion, whatever may be the consequences; we owe it to the truth, to true progress, and to the prosperity of an industry which is of importance to us in more ways than one.

The defective methods of manufacture which have been adopted by the producer of sugar are the primary cause of the evils which we have noted in the refined sugars of commerce. These evils might exist at a former period, but then they were the consequences of the normal glucose impurity of colonial sugars.

During the whole time that the sugar industry carefully practised the alkaline system, refined beet sugars were free from glucose as well as the raw; and when it was found in the products of refineries worked on this principle, it had its source in the admixture of colonial sugars and in the erroneous methods used in refining.

In fact, we may recollect that at another period the slowness of

the process, and the system followed in refineries were peculiarly favourable to the transformation of crystallizable sugar into glucose by fermentation.

We have proved by experiment that beet sugars actually sold and delivered are often acid, and if they are slightly alkaline on leaving the factories, they lose this character after being warehoused a short time.

We have proved by analysis of some boxes of the official standard sugar that this alteration is produced in time, even in the small samples; and that this modification appears to be the more active and the more rapid when the recently made sugar is of whiter colour.

What can be more paradoxical than these facts? It is generally, and always has been believed, that the whiteness of the sugar is an indication of its purity: that the whitest sugars are the purest, and keep the best.

Is this principle false? We do not admit it; but the case we are considering is exceptional, and it is easy to understand and explain it.

The calcic boiling in the free air, which produced good alkaline sugars in the old process—that is to say, sugars strongly crystallized and freed from molasses, but of a yellow or red shade, was the true cause of these qualities; and in preserving to the manufactured sugar the original alkaline character, it had radically destroyed the nitrogenous matter which tended to produce fermentation. The sugars thus purified might be kept in the warehouse without alteration; they refined well, but their coloration was carried into the produce; and notwithstanding the use of more animal charcoal to decolorize them, they produced sugar of a yellow cast, which to the eyes of ignorant consumers, and these are by far the larger number, if not the generality, were depreciated.

The washing with syrup, which in the refinery completes the bleaching and purification of the loaves, required also a much greater consumption of white sugar and more time for working.

To avoid these inconveniences some purely speculative workers have carried out this fact or illusion, that in suppressing the boiling with lime the syrups colour less, and that in submitting them to

new apparatus they prevent calcareous incrustations. Thus notwithstanding their really evident vices, these syrups can be submitted without difficulty to a crystalline purification, known by the name of "cuite en grains."

Armed with these methods, the pretended inventors have based their speculations upon them: they have conceived the double carbonatation, the turbid defecation, and all those irregular modifications of known agents and processes which alter the products and substitute for the real some fictitious qualities, which finally conduce to the results which we have noted.*

The refiners who at a former period were the promoters and regulators of the progress of the sugar industry by giving for a long time the preference to the products of the alkaline method, have become in an interest perhaps little understood, the promoters and accomplices of a vicious method of manufacture.

The white grainy sugars, despite their radical vices, have the great advantage of being easily worked, which alone captivates the affections of the refiners. Their apparent purity, judged of by their colour, † allows of their being used without the

* These pretended progressive inventions had rise in Germany, where they are carried out with the same assurance, the same ignorance, the same effrontery, as in France. There, in fact, analyses made by the doctors have been shown, which establish by figures that the "turbid defecation" removes half of the impurities of the juice, and thus doubles the value of it. We have affirmed from the results of the most exact experiments that this process only eliminates the colouring principle; and that as regards the salts and the nitrogenous matters, the juice is inferior to the produce of the common alkaline method. On which side does the truth lie? Only ulterior discussion will show.

† It is believed that the manufacturers of white grainy sugar employ against the refiners the same subterfuge which the latter use against their customers—that is to say, they give them a blue tint which produces a fictitious white appearance, without which their impurity would be shown by the yellow cast. It is, in fact, known that refiners put into their loaf coppers some ultramarine, of which the blue colour, combined with the yellow colour of the impure sugar, produces a whiteness in accordance with the law of complimentary colours. This is, saving the difference of the

centrifugal or any other process whatever, either for washing loaves or as raw material for refining, and when added to the charge in the vacuum pan, they raise the colour of the concentrated syrups, and reduce the volume of the low products, which are, as we know, the most radical obstacle to the working of a large quantity.

Such are the real motives which have induced the refiners to accord a higher value to the impure white grainy sugars of commerce, and which have exclusively encouraged this kind of manufacture, and attributed to it a superiority, which is very questionable.

In fact, all the sugars produced by these new methods of manufacture are more or less defective, and the high price which refiners give for them is very often the result of an illusion or of erroneous calculation.

Already there is a little reaction from this infatuation, and the difference in price between the white and yellow sugars, which has been sometimes as much as 15 to 18 francs per 100 kilos. has now fallen to 9 or 10, at which it now regularly stands; but if the subject is thoroughly ventilated, the white grainy sugars will lose the favour they at present enjoy, and may even be driven from the market with as much ardour as they have found favour without sufficient reason.

Already less importance is now attached to the colour which has served as the basis of an absurd official classification. Saccharimetrical and saline analyses have commenced the work of the regeneration of the trade in sugar, and when new light is thrown upon the question, complete justice will be done by restoring the industry to the path, which it never ought to have abandoned;

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colouring principle, the usual method of our laundresses, who correct the yellow tone of the badly washed linen with cobalt-blue. The principle is exactly the same in both cases; and, in fact, it is an unheard of thing that sensible men should be carried away by routine to practise such methods to give a purely fictitious character to a commercial product of the first importance—an article of food! Should not the consumer oppose this underhand dealing by refusing all sugars which, dissolved in water, eave a blue precipitate.

by a return to the alkaline working of sugars, which will keep well—*i. e.*, to sugars free from glucose and from glucose ferments.

Doubtless the refiners are able to bring about this renovation of the sugar industry by proceeding as they formerly did at another period; that is to say, at an epoch when the industry, misusing the vacuum apparatus, delivered faulty sugars, of which the defects were immediately shown in the process of refining.

The existing defects are of the same order, although balanced by certain illusory advantages which favour more or less the desires of the refiner, as we have noted, and facilitate the working of a large quantity; but the quality of the produce is certainly deteriorated, as is proved by the invariable presence of glucose in the refined sugar of commerce.

The discovery of glucose and its quantity is, then, of great importance from our point of view, inasmuch as it will enable the refiner to enter on the path of perfection which we have pointed out.

To attain this end mark the course that must be taken—

All raw sugar white or other, which is not freely alkaline, should be suspected, and if experiment shows that it contains glucose, it should be subjected to precise examination to determine its value. Thus, if the sugar has an acid reaction, and if its glucose analysis shows the presence of true glucose, and not of its derivatives, it should lose the place which its colour and granular crystals have given it, and submit to a rebate.

Such a sugar, in fact, used in the refinery always introduces not only glucose ready formed, but also ferments which produce this impurity; it thus becomes a means of the modification of crystallizable sugar, which it is sought in vain to combat by calcic alkalinity. In this case, in truth, when the analysis only shows in the sugar in question some thousandths of glucose, it is not on an equivalent quantity that rebate shonld properly be made, but on hundredths, because such a sugar made in the refinery alters some hundredths of good sugar, and therefore a rebate expressed in hundredths would be perfectly legitimate and justifiable.

Besides, the fault of this sort of sugar can be discovered by other

indications. Thus, sugar stored in large samples, as in bags, if not completely dry, undergoes fermentation, and loses its free granular state, and clots together, like farina in the heat of summer. The sugar also contracts a characteristic odour.

In submitting this sugar to what we have termed the calcic proof, it gives off ammonia, easily recognised by the smell. In fact, every circumstance connected with sugar of this sort shows the evils of defective manufacture; that is to say, of an incomplete defecation, which, while promoting the blanching of it, leaves impurities in the syrup which an alkali would eliminate or transform.

We submit that even an exaggerated rebate, based on the presence of glucose, or its derivatives, in the sugars of commerce, is perfectly just, when these impurities are the result of a vicious system of manufacture, and it is evident that this rebate, considered as a fine, would have for its aim and effect the turning of the sugar manufacture away from a false system, which has been adopted under the pretence of progress.

Let us see what would be the effect of this on the sugars of commerce, and consequently on the sugar industry.

If the alkaline process again takes the lead in our sugar factories, the raw sugars will recover their rank according to quality, and it is evident that this return to true principle will not prevent in any degree legitimate improvement which may be sought for from the carbonic decoloration, animal charcoal, or the centrifugal, from perfected apparatus and from all the processes of purification which have for their aim the delivery to the refiner of the purest and whitest sugar possible.

In these conditions sugars containing no glucose, and freely alkaline, may be warehoused without the fear of any alteration or fermentation; they would not afford to the refiner any pretext for a recognized allowance, whilst they would be free from the evils which at present affect the working and the produce of refineries.

In such conditions, and with such raw material, the refiners would be able, as advantageously as the makers, to adopt the alkaline method, and enjoy the benefits of this process, which is

eminently preservative of the sugar, and which cannot be carried out while the present system prevails.

In fact, the glucose alteration being caused by the impurity of the raw material, begins to appear in the first process of the refinery—*i.e.*, in the melting, and is invariably developed during all the subsequent processes; if, to combat this evil, the refiners have recourse to the calcic alkalinity, then from the clarification downwards, they transform the normal glucose into its derivatives, producing in it the known coloured derivative, and this mode of working by colouring the boiling syrup, annuls the benefit expected from the introduction of white grainy or centrifugal sugars into the pan.

The refiners, then, are obliged, in view of their mode of working, to take account in their offers, both of the pre-existing glucose and of the glucose ferments. This is the least of the evils in the present state of the question, and when they use the lime to neutralize, it is only in working low produce, and with the single aim of combating the frothy fermentation.

By only one means can the refining industry overcome this difficulty, and that is the return to the alkaline method in the sugar factory, when the raw material being delivered free from glucose, a similar mode of working may be pursued in the refinery.

Then and then only refined sugars can be delivered to the consumer free from glucose, and then perhaps, also, it may be demanded of the refiners that they cease to apply to the sugar which we eat, the factitious process of bleaching, which the laundress applies to our linen.

The latest news from the colonial sugar countries is generally favourable both as regards the present and the coming crops. In Mauritius rain is required for the growing canes, but the hot dry weather has been favourable for the cutting of the present season's crop, which is still estimated to yield 125 to 130 thousand tons, of which it is expected that 50 thousand tons will be shipped for Europe, an equal quantity for Australia, and the remainder to India.—*Licht's Monthly Circular.*

ON SULPHITE OF PHOSPHATE OF LIME, THE NEW DISINFECTANT AND MANURE.

BY DR. B. WILHELM GERLAND.

ALTHOUGH the number of disinfectants is limited, the choice of a suitable one is difficult, as they all have some property which makes their use inconvenient. The most effective is Chlorine, but, being poisonous and destructive, it must be rejected in important cases. Carbolic acid is well known as an antiseptic; however, it deodorizes only by substituting its own strong smell. The metallic Salts and the Permanganates are in many instances very valuable; their disinfecting action is, however, limited to those substances with which they are brought into contact; but as they stain or destroy tissues, or other organic matter, and are expensive and poisonous, their use is restricted. Of greater importance is Sulphurous acid. Even small quantities have a surprising effect, and it is therefore used by several trades. Its application is easy, when it can be made by burning Sulphur at the place where it is wanted; but it is a highly irritating gas, even when mixed in minute proportion with the air, and rapidly tarnishes metallic surfaces, so that we can neither use it in our dwellings or stables. The aqueous solution of Sulphurous acid has not many advantages over the gas; its preparation is troublesome, its smell very strong, although containing but a few per cent., and it is rapidly affected by the air. The Sulphites are still more susceptible to this; moreover, their disinfecting power is considerably less than that of the acid; in fact, I have repeatedly observed, that when mixed with putrid matter they accelerated the decomposition, which was soon accompanied by an abundant generation of sulphuretted hydrogen. With these considerations I undertook an investigation of Sulphurous acid, in the hope of finding a suitable combination, and discovered a series of compounds of this acid with tribasic Phosphate of Lime, which are possessed of properties that are certain to make them interesting and important.

SOLUTION OF PHOSPHATE OF LIME IN SULPHUROUS ACID.—An aqueous solution of Sulphurous acid dissolves tribasic Phosphate of Lime, in whatever state it may be. If the gas is passed through water holding an excess of precipitated Phosphate of Lime in suspension, a solution of 1·3 sp. gr. is obtained. According to the analysis, it contains for one equivalent tribasic Phosphate of Lime, six equivalents Sulphurous acid, as the comparison between the numbers found and those calculated from that formula will show :—

ANALYSIS OF THE SOLUTION OF 1·300 SP. GR. 1,000 c. c. contain :—				The formula, $3\ CaO, PO_5, 6\ SO_2$, requires :—		
Sulphurous acid ..	218·38	Grms.	....	$6\ SO_2$ ..	192 ..	224·45
Sulphuric acid ..	0·70	,,	....	..	..	
Phosphoric acid ..	82·89	,,	....	PO_5 ..	71·4 ..	82·89
Lime............	101·79	,,	....	$3\ CaO$ ..	84 ..	98·20
	403·76	,,	....		347·4 ..	405·54

Sulphurous acid also dissolves bone ash, but it acts slower than in the former experiment, nor have I yet succeeded in preparing a solution of such great density. The strongest solution obtained from bone ash had a specific gravity of 1·1708, and this liquor contained, in 1,000 c. c. :—

Sulphurous acid......	141·82	grms.
Sulphuric acid		
Phosphoric acid......................	47·42	,,
Magnesia	2·79	,,
Lime	59·69	,,
	251·72	

The formula $3\ Ca\ O, P\ O_5, 6\ S\ O_2$, requires for 47·42 Phosphoric acid :—

Sulphurous acid..................	127·50	
Phosphoric acid..................	47·42	
Lime	55·78	
		230·70
Excess of Lime of the analysis		3·91
,, Magnesia ,, ...		2·79
These two require Sulphurous acid		8·73
Excess of Sulphurous acid found		5·58
		251·71

The liquor contains Lime and Phosphoric acid in nearly the same proportion as the bone ash, but considerably more Magnesia; in fact, the Sulphurous acid has dissolved all the Magnesia of the bone ash, which was left in excess in the solution.

The proportion of Sulphurous acid in these liquors varies according to their strength. Those, for instance, of 1·060 sp. gr., contain 5 equivalents Sulphurous acid for 1 equivalent Phosphate of Lime, and in still weaker solutions we find this proportion reduced to 4 to 1.

These liquors have the smell and taste of Sulphurous acid, but to a considerably less extent than aqueous solutions of the gas with the same amount; nor do they lose it so readily, and contain a much greater quantity. As the Sulphurous acid has not lost its disinfecting power in these solutions, they are likely to prove of great value. They give remarkable reactions, but most of them being of purely scientific interest, we will omit them here, particularly as they are described in other places. The following, however, is of greater importance, and of more general interest:—

When the solution of Phosphate of Lime in Sulphurous acid is boiled, a precipitate is formed, and the latter escapes as gas. This decomposition requires long-continued boiling, considerably more than an aqueous solution of Sulphurous acid would need, to deprive it of the gas. The precipitate is white, crystalline, and dissolves under the microscope into hexagonal crystals, showing the faces of the column and the pyramid.

The analysis of the precipitate dried over sulphuric acid gave the following numbers:—

Sulphurous acid	15·61
Sulphuric acid	0·23
Phosphoric acid	34·48
Lime	39·89
Water	9·09
	99·30

These agree with the formula, $3\ Ca\ O,\ P\ O_5,\ S\ O_2,\ 2\ H\ O$, which requires—

Sulphurous acid	15·58
Phosphoric acid	34·76
Lime	40·89
Water	8·77
	100·00

The substance is, consequently, *Sulphite of Phosphate of Lime.* It distinguishes itself from all other Sulphites by its stability, and is a white powder free from smell and taste, does not change in any way in either wet or dry air, or in the steam bath. After having been heated for three hours in an air bath to 130° C., it had lost 0·64 per cent. of water, whilst the amount of Sulphurous acid remained the same as before. The water is held strongly, and cannot be expelled except by a higher temperature, when at the same time a deeper going decomposition takes place, in consequence of which fumes of Sulphuric acid, metallic Sulphur, and Sulphurous acid, are given off with water; but the residue contains Sulphur, as Sulphate and Sulphide, even after having been heated to redness.

This Sulphite is insoluble in cold water. Long-continued boiling under exclusion of air causes a slight decomposition, and the water contains Phosphoric acid in very small proportion (according to my estimation, 0·02 per cent.)

Strong mineral acids decompose the compounds under effervescence of Sulphurous acid. Oxalic acid acts but very slowly on it, even when boiled. Acetic acid has scarcely any effect upon it; assisted by heat and the oxidizing effect of air, it dissolves it gradually.

Chlorine gas is readily absorbed by the dry powder, Sulphurous acid is oxidized, but no Sulphuric acid is formed, and only small quantities of Phosphate are rendered soluble. Dilute Iodine solution is instantaneously discoloured by the new compound, and the process is terminated when it is completely dissolved; a further addition of Iodine produces a permanent color. This affords an accurate and convenient mode of testing the amount of Sulphurous acid. The decomposition takes place according to the formula,

$$3\,CaO, PO_5, SO_2, 2\,HO + I = CaO, 2\,HO, PO_5 + CaO, SO_3 + CaI.$$

The Sulphite of Phosphate of Lime, although it perfectly resists the atmosphere, is speedily oxidized when buried in the earth. The following experiment explains the process undergone:—A layer of the compound, $1\frac{1}{2}$ in. thick, was placed in a heavy clay soil (this was ascertained to be free from Lime and Phosphoric acid soluble in dilute Hydrochloric acid), covered with the same, and well beaten down. This sample was exhumed after two months (in October), and a portion with as little soil as possible submitted to analysis; 100 parts were found to contain:—

Sulphuric acid	18·59
Phosphoric acid	24·58
Lime	33·66

Sulphurous acid was not present. The Sulphite was oxidized, and this will have taken place according to the formula,

$$3\,CaO, PO_5, SO_2, 2\,HO + O = 2\,CaO, HO, PO_5 + CaO, SO_3 + HO.$$

The original substance contained, according to analysis (see p. 41), 34·5 per cent. Phosphoric acid, and 15·8 per cent. Sulphurous acid, which by oxidation yields 19·75 per cent. Sulphuric acid. The exhumed substance ought, according to this proportion, to contain

for the quantity of Phosphoric acid found, namely, 24·58, 14 per cent. of Sulphuric acid; but the analysis shows 18·59 per cent.: that is an excess of 4½ per cent. sulphuric acid. It is therefore evident that the Phosphate has been dissolved at a quicker rate than the Sulphate of Lime. Calculating from the quantities of acids of the last analysis, the quantity of Lime which they require, we find,

	Per cent. Lime.
For 18·59 Sulphuric acid as $Ca\,O, S\,O_3$	13·01
And for 24·58 Phosphoric acid as $2\,Ca\,O, P\,O_5$	19·28
Total	32·29

But the exhumed sample really contained 33·66 per cent. Lime, or 1·37 per cent. more. Such an excess is to be expected when we consider the tendency of dibasic Phosphate of Lime to undergo a decomposition under the influence of water, by which a compound containing more Lime is left undissolved.

The Sulphite of Phosphate of Lime will therefore act when mixed with the soil, like a soluble Phosphate, and has the advantage over the latter of containing a higher percentage of Phosphoric acid, and of becoming soluble by degrees, so that floods and heavy rains are not likely to wash it off the land.

The new compound has the property of absorbing Ammonia when it is mixed with air, and this is probably of great importance for its functions as a disinfectant, as will be explained presently. It appears, however, that as ammonia is absorbed, the equivalent of Sulphurous acid becomes oxidized, and forms Sulphuric acid. A sample was placed under a loose shade beside a dish with water, and pieces of Carbonate of Ammonia, for four weeks, and subsequently for two days over Sulphuric acid. It was then found to contain :—

	Per cent.
Lime	39·08
Sulphurous acid	2·50
Ammonia	5·60

The Sulphite of Phosphate of Lime possesses antiseptic and disinfecting powers to a remarkable extent. When applied to putrid matter it will, in all probability, begin its action by absorbing the free Ammonia, and this is of importance, as the Ammonia, a product of putridity, greatly accelerates the same, and, being a highly volatile substance, will carry off other products of decay, which by themselves would not volatilize, or only sparingly. The new Sulphite goes further in its action: it arrests decay, and the worst smell will soon be greatly diminished and changed, or altogether removed. The most offensive putrid matter will by this means be rendered innocuous. The process by which this disinfection is accomplished is not yet sufficiently ascertained, but I have convinced myself that the larger the mass of matter, and the more advanced in putridity, and the warmer the temperature, the quicker and the more perfect is the action of the Sulphite. The Sulphurous acid becomes oxidized, and it is not unlikely that Ozone is formed at the same time. Nitric acid is found in every instance. It is astonishing how well sometimes this powder acts in disinfecting putrid matter when at a distance from it. For hot climates this disinfectant will prove of great benefit, and after having served its purpose, the resulting mixture of the same with organic matter will be a valuable manure.

My new Sulphite is of great value for stables and shippons When regularly strewn over the floor, a small quantity will be sufficient to remove the ammoniacal smell so peculiar to these localities. The beneficial effect of pure air upon health is generally acknowledged; how, then, can we expect domestic animals to thrive in stables where the air is often contaminated with Ammonia to such an extent that the rudest tests will show its presence? The regular application of this disinfectant is consequently of a threefold advantage to the farmer: it keeps the air in the stable pure, it enriches the dung with Phosphoric acid in a soluble state, and with Ammonia, which otherwise would be lost. The Sulphite will save more Ammonia than it is able to absorb, as, by preventing the decomposition of the dung, it prevents the formation of Ammonia, and leaves the organic substances containing Nitrogen

intact, until the dung is brought on the land. Since the Peruvian guano fields are approaching exhaustion, the value of Ammonia is increasing, and it is a matter of importance to utilize that which we have at our doors, instead of allowing it to waste, and vitiate the atmosphere. It would be advisable to keep the dung under roof, so that the rain cannot wash off the most valuable constituents.

The Sulphite of Phosphate of Lime combines with its disinfecting power properties which recommend it for general use. It is a nice white powder, inodorous and tasteless, staining nothing, it easily dusts off garments, carpets, &c. It does not affect the most delicate colour or tarnish metals, and is perfectly harmless to animal life. Finally, it is a definite chemical compound, and therefore of regular composition.

These properties are also likely to recommend it for trial in Therapeutics.

All attempts to prepare a compound of Phosphate of Lime with two equivalents of Sulphurous acid have failed. The investigation of this subject is still occupying me, bnt as the described compounds of Sulphurous Acid and Phosphate of Lime are of great scientific interest, and are likely to become of importance for agricultural and sanitary purposes, particularly since they are now articles of commerce, I give the results so far obtained to the readers of "*The Sugar Cane.*"

Macclesfield, December, 1869.

THE CONCRETOR IN AUSTRALIA.

WE have been favoured with the perusal of a letter from Dr. Nield of New South Wales, giving an account of the trial of (we believe) the first Concretor erected in any part of Australia. Whilst the letter shows that there are great difficulties to be overcome in the introduction of new apparatus into a comparatively new country, the results so far are of a decidedly encouraging

character. By permission we reproduce the letter in our pages, being sure it will interest many of our readers.

New South Wales,
Port Macquarie,
October 4, 1869.

DEAR SIRS,

I need not trouble you with a very long letter this month, but must be content to report progress. We, or rather I, have finished erecting the Concretor, the brickwork of the furnace being our *béte noire;* and have had three small trials, conducted according to the printed instructions and Mr. Fryer's most admirable hints. *None of us* who worked the Concretor had ever made a grain of sugar before, and I must own to a sense of temerity in venturing to use so beautiful and admirable, so complex, yet so simple, an apparatus. But we were careful, and had no accident. The brick-work was not dry, our fuel not good, the trays, especially the wrought-iron ones, were loaded with rust and dirt, which we could not get off at first. Everything was dirty, cylinder full of dust, our hot air did not reach 230°, other end not 100°, the defecation in the clarifiers was most imperfect, and there was more or less of salt water in the pipes (we are compelled to use salt water for our boiler). We did not expect any result but a mess; yet, despite all this, in two hours after being discharged, the concentrated material—I cannot call it syrup, it was so poorly cooked—began to granulate, and next morning (we had to finish it by lantern light) there was a good body of sugar. This was centrifugaled and liquored two days afterwards, and yielded a very light grey sugar—grey from being tinged by the rust, yet of a nice sweet taste. I should have previously stated that the cane crushed had lain long on the ground, blown down, but not broken off, and that the juice marked only 8½ to 9° Baumé. The mill expresses 60 and 62½ per cent. of juice. We felt—and our better experienced visitors expressed—that our result was a great success. Two days after our first crushing we tried a second; but our colonial steam boiler could only give us 10 to 17 or 18 lbs. of steam. Hence the boiling

quite overran the crushing, and we had to stop—not, however, till we had turned out many gallons of rich syrup, which began to crystallize almost immediately. Our boiling had been much better, but fitful, owing to a furious Nor'-wester, and our heat had risen to 280° and 130°. We ended our day at the centrifugal as just named. On our third boiling things went better than ever. The juice was in a rich amber foam from end to end of trays, yet no burning; the heat was 330° to 150°, the discharge was going on continuously, and good-sized crystals formed in the shoot in the cylinder. We, however, ran the sugar and syrup into coolers to crystallize fully. We must centrifugal it when our boiler funnel has been put up again; we have taken it down to add 12 feet to it. I am quite satisfied with the Concretor and your beautiful machinery; both will do all promised for them, provided I have a proper supply of steam, and this I am hastening to get. I consider we are quite successful, but shall use coolers for the present, till our sugar runs so freely in the side shoot as to tempt us to put it at once in the centrifugal.

One of my visitors is the manager for the Sydney Sugar Company of their large Concretor (about being erected) on the Macleay. He was well satisfied—more so, by far, than myself—and declared that what he had seen us novices accomplish had taken a load of anxiety from his mind. I can assure you it has marvellously lightened my anxiety also. I believed in the Concretor, yet, when I found myself nearly alone in standing up for it, and was pitied for my blindness, sneered at for my folly, censured for my rashness, and laughed at by ignorance—when professed experts predicted my utter ruin, and even kindly acquaintances could give me no more encouragement than a cool "hope you will succeed," or a silent disbelief expressed by the eyes—I must confess to having had many an anxious hour, and no little burden to bear. But, as "nothing succeeds like success," smiles and congratulations are being exchanged for sneers and pity and "hopes," and my energies are being restrung to complete my works, and get through my work of this season.

Sincerely yours,

JOHN C. NIELD.

MEMORIAL ON THE SUGAR DUTIES.

IT appears that a memorial has been drawn up in Antigua, for presentation to the Home Authorities, asking in the first place for a reduction of the duties on sugar to one uniform rate of 4s. 8d. per cwt. Antigua is not the place in which such a memorial might be expected to originate, and it appears, from voluminous correspondence in the island newspapers, that the planters there are by no means of one accord on the question—as will be seen by an extract from one of the letters on the subject :—

"I trust the planters of Antigua will pause before they sign a memorial, the effect of which, if granted, will be to hold out a heavy premium to the refined sugar of Cuba, the vacuum pan sugar of Demerara, and the beet-root sugar of France and Germany, by taxing these *at the same duty* as their own muscavado. The Committee decided that the duty should be levied as nearly as possible on the amount of *extractable saccharine matter* in the same way that the customs charge duty on rum—according to the quantity of alcohol it contains. Would the writer of the memorial propose that our Leeward Island rum of low proof should pay the same duty per gallon as the high proof rum of Demerara and Jamaica?—I trow not. Then why should he seek to tax pure saccharine at the same duty as our sugars, containing as they do, a large proportion of matter, not saccharine?

"The argument that the differential duties afford a premium for making bad sugar, is altogether fallacious. What it *does do*, is to allow the planter of small means who cannot afford to erect a refinery, or a vacuum pan, to enter the market on as nearly as possible equal terms with his richer competitor. Nor is the argument comparing tea with sugar a happier one, as every one knows, or ought to know, that common congou, at 10d., is as pure *tea* as souchong or pekoe, at 1s. 6d. or 2s., and, unlike muscavado sugar, is not combined with any *foreign matter*.

"The statement in the memorial as to the mode of assessing the duty, even if true, does not in any way affect the principle of a

scale of duties. The science of the present day is quite capable of detecting the amount of saccharine matter in any sample of sugar, and I cannot imagine, if the present mode of assessing duties is so "vicious" as is described, how men of intelligence, as our merchants and brokers undoubtedly are, can submit to it. However, as I have said, this can in no way affect the principle, which is to tax the *saccharine* and not the matter with which it is combined in raw sugars.

"If the writer would separate his application for equalization, and apply only for reduction or abolition, he would have, I believe, the unanimous approval not only of this, but of every other West India sugar-producing colony."

"I am, sir,

"Yours respectfully,

"P. BURNS."

In some of the replies to Mr. Burns, and also in some remarks in a Barbadoes paper, the opinion is expressed that, if equalization of duties would be detrimental to some interests, total abolition would be much more so. It is scarcely needful to invoke the authority of Political Economy to confute this fallacy, the absurdity of which is apparent. With neither duties nor drawbacks, no one interest could possibly have any fiscal advantage over another; but a fixed duty would favour the foreign refiner at the expense of the producer of raw material, and in direct proportion to the amount of the duty; thus, at a fixed duty calculated to produce the same revenue as the present graduated scale—say 10s. per cwt.,—10 cwts. of loaf sugar would pay 100s., or 10s. for each cwt. of pure sugar; 10 cwts. of fine Havanna would equally pay 100s., and as 9 cwts. of pure sugar would be extracted from it, the duty would be about 11s. per cwt. of pure sugar; 10 cwts. of Muscavado would also pay 100s., this would yield 8 cwts. of pure sugar, which would thus pay 12s. 6d. per cwt. Manila, Jaggery, and other low sugar would of course pay proportionately more. It comes then to this—that on one uniform rate of 10s. per cwt., French beet-root sugar made into loaves would pay 10s. per cwt.; slave-grown Havanna, 20s. per ton more; and the produce of the island of Antigua, 50s. per ton

more. But the buyer would simply buy the cheapest sugar for his money; the beet-root refiner would be protected, and the grower of low sugar injured, to the extent of the difference; and the ultimate but inevitable effect would be, that the Antiguan planter would have to sell his sugars at an average of 30s. per ton less than at present, a tax on the island of something like £20,000 per annum, from which the British consumer would not derive the slightest benefit, but which would be paid in the shape of higher prices, mainly to foreign refiners and producers of beet-root sugar. The principle is just the same whether the fixed duty be 10s. per cwt. or 5s.; and supposing Mr. Lowe could be induced to spare half the revenue from sugar, and fix it at 5s., the result would, in each case, be just half what is indicated above.

If, instead of asking for the reversal of the policy pursued on the sugar duties for so many years,—a policy approved by the most eminent modern statesmen and financiers—the Antigua memorialists had petitioned for their total and immediate repeal, their appeal would have had greater weight. All classes interested are in favour of *this* solution of the question; with freedom of trade no interest would be protected or injured, and without giving to our sugar colonies any fiscal advantage, it would greatly promote their prosperity, and strengthen the ties which bind them to the mother country.

STATE OF CUBA.

ACCORDING to a correspondent of a New York paper, "the civil war in Cuba" has degenerated into a savage butchery.

It is said that eight thousand men are about to be sent to replace fourteen thousand Spanish soldiers, who have fallen through the casualties of war, or become victims of yellow fever and cholera; and that the same fate will probably befall the fresh reinforcements, for, according to the latest news from the more important points—as the isle of Satiago de Cuba, for instance—the

yellow fever and cholera are making fearful ravages. The Cubans, it is stated, are prepared for all extremities, rather than submit longer to the yoke of Spain, as a proof of which, a proclamation of Cepedes, the chief of the insurgents, is cited, to the effect that, in order to deprive the Spaniards of the revenues derived from sugar and tobacco, he has ordered the destruction of the plantations of both of these. The writer adds that in proof of the prevalence of the "fanaticism of independence," which recalls the worst periods of the civil war in the United States, this order is being carried into effect—that the most beautiful plantations are being reduced to ashes—and that very shortly, if the Cubans are left to themselves, the Pearl of the Antilles will be nothing more than a vast desert.

This account, considering its source, must of course be taken *cum grano salis.* Nothing is less likely to promote the popularity of the insurrection amongst the influential class of Cubans than the mode of warfare above described; indeed, it may be taken (if the account is true) as a proof of the weakness of the insurrection, rather than of its strength.

From the Antigua Times.

Some time since we noticed the arrival of two steam ploughs in the island, and remarked on the occurrence as a proof of the progress of enterprise in Antigua. Since then another event has occurred which we think bears out still more fully what we said then. We allude to the importation by "Fryer's Concrete Company, Limited, of their fourth Concretor. This machine is, we believe, intended for the Belvidere estates, and will, from its size, nearly double the power of the factory there. It is of the largest style, with all the recent improvements; and its erection gives proof, if any were wanting, that the company is not likely to let either the cultivation of its own estates or the purchase of canes (of the benefit of which, to the small holder, we have before spoken) languish for want of a judicious expenditure.

PROSPECTS IN BARBADOES.

FROM A LETTER, BY S. T. HARDY, IN THE REPORTER.—The sugar-crop of 1869 has indeed proved woefully short—considering the acreage under canes, (to say nothing of the expense of its preparation and manuring), and I suppose it has been the worst since the abolition of slavery in 1834, as regards the money realized by its sale. In hhds., putting aside small packages, the exports of 1869 are only 27,000 as against 51,000 hhds. the previous year; in fact, about half a crop. With our present extended system of planting, I believe there are 35,000 acres under canes every crop—less than 50,000 hhds. sugar, annually exported, will not "pay" at the ordinary price of sugar. The quality of Barbadoes sugar, in such a dry season as the last, is necessarily inferior to that produced from canes arrived at perfect maturity. We have found the quality of this year's shipments worse than for many years—as recent letters from the principal consignees have mentioned. The state of the English and American markets has, fortunately, enabled merchants to get out of this year's sugar at better prices than they obtained for the superior crop of 1867-8. This has helped us. Also the unusually large yield of molasses has found a very good market in the island with American buyers.

We are now approaching a new year and "the next crop." It is unnecessary to dwell on the nature of the growing season of 1869. I did hope early in June, when the country was looking well, and crops starting from a long lethargy began to grow vigorously, that, with favourable weather to the end of the year, we might find 50,000 hhds. exported in 1870. After so many hard knocks from the repeated spells of drought since then, I fear it is now only too probable we are in for another short crop as a whole, though I expect not a few plantations will do better in 1870 than in 1869.

As a community, we find ourselves now so much the poorer as compared with our position a year ago, that another short crop is a serious prospect; some say it is a calamity or judgment. Rather

let us regard it as a timely warning—"a blessing in disguise." Here we are depending too much on one precarious and most uncertain plant, with a swarming and increasing population, and nature (so to say) has placed us in a position, in many important respects unrivalled, for attracting a goodly share of the trade of the world passing our shores.

There is, I think, too great imgortance attached to land-owning here, and, (as our late Governor pointed out in his "Blue Books,") a struggle for possession of land in our crowded island results in the giving of enormous prices, and a hand-to-mouth existence, when buyers have little capital. A 'rise in price' of sugar increases the evil, and our true interests seem to be that sugar should remain at an equable and moderate value. I should regret, therefore, to see prices rise any higher than the average of the present year.

FROM GOVERNOR RAWSON'S ADDRESS.—Ere long, Steamers will be established on all the main lines of commercial traffic over the face of the globe. Two lines now touch at Barbadoes. Two other lines, one connecting New York with South America, the other projected to connect the Dominion of Canada with British Guiana, are desirous of doing so. The establishment of telegraphic communication with Europe and North America, which will enable passing vessels in the Australian and South American trades to receive orders here, the first and most favourable point of the globe for that purpose, will open a new and vast field for the traffic of Barbadoes.

SORGHO SUGAR.

(From the American Grocer.)

MACON, GA., Nov. 17, 1869.

Among the articles on exhibition are four specimens of sugar made from the sorgho cane. The sugar is excellent. It ranges from white to brown. The importance of this matter cannot be over-estimated. For a long time the practicability of making

sorgho sugar was in great doubt, and even after this was determined, it was in still greater doubt whether it would pay to do it. These matters are settled, and triumphantly settled, in favour of the sugar.

This sugar was made in Atlanta at the Sorgho Works of Glenn and Wright. We give the results of the working of this system of sugar making. One gallon of syrup will make from five to seven pounds of sugar, and leave a quart of excellent syrup. An acre of cane will give a hundred gallons of syrup, or from five to seven hundred pounds of sugar, and one hundred quarts, or twenty-five gallons of syrup. The sugar is worth 20 cents per pound, or 100 dols. for the 500 pounds. The syrup left is worth 1 dol. per gallon, or 25 dols. for the 25 gallons. Thus 125 dols. per acre gross is realizable from each acre of cane.

In South-western Georgia, planters have on the same quality of land made more money on their sorgho sugar than their cotton.

The South Carolina State Agricultural Society has recommended the making of this sugar by this plan to the planters of the South.

As the cane will grow all over the State, it will behove all of our farmers to look into this matter.

NEW PATENTS.—FROM THE MECHANICS' MAGAZINE.

1486. J. H. JOHNSON, Lincoln's Inn-fields. *Treatment of Beet-root.* (A communication.) Dated May 14, 1869.

The object is to provide a straining or filtering surface for the pressing cylinders used in treating beet-root, which shall not be liable to become clogged by the adhering thereto, or the accumulation thereon, of the solid or tenuous particles of the pulp, the openings being at all times perfectly permeable, whilst the juice itself is allowed to passed through them in a highly pure condition. This result is obtained by the use of a smooth metallic, filtering, or straining surface, that is to say, a surface presenting no rough parts to which the pulp can attach itself.—Patent completed.

1498. F. KOHN, Robert-street, Adelphi. *Extracting juice from sugar.* (A communication.) Dated May 17, 1869.

This consists in carrying out the whole process of diffusion in one single vessel or diffuser, in which the sugar extraction is carried on continuously by introducing the slices of cane, beet-root, or other plants through a feeding apparatus at the bottom of the vessel, from which they rise slowly and gradually to the top, while the fresh water is constantly running in at the top of the diffusion vessel, and is drawn off at the bottom as diffusion juice, after having remained in contact with the slices for a sufficient length of time.—Patent completed.

1511. W. R. LAKE, Southampton-buildings. *Drying sugar.* (A communication.) Dated May 17, 1869.

The time for drying sugar loaves in the ordinary manner is from eight to twelve days, but with this improved apparatus the time is reduced to twenty-four hours. This improvement is obtained by producing complete currents of heated air in the loaves themselves.—Patent abandoned.

FOREIGN PATENTS.—FROM "LA SUCRERIE INDIGENE."

84311. M. HANON A BETHUNE, Pas de Calais. *Apparatus for heating and evaporating liquids.*

This apparatus is composed of two concentric vases, the interior, which is open at the top, is fitted with two or more serpentines for the evaporation of the liquid. The second vase, which is closed at the top, envelopes the first on all sides, and receives in the space which separates them the vapour thrown off by the boiling liquid. This vapour, which escapes by a flue at the bottom of the vase, cannot reach this opening until it has traversed up and down five compartments into which the space between the two vases is divided. Into the first of these compartments the waste steam from the steam engine may also be turned.

84731. M. M. JUGL ET KODL, Austria. *Process of clarifying and purifying sugar in the moulds or other receptacles by means of the clearing syrup with high pressure either of air or water.*

The moulds for the loaves are placed as usual, but are provided with a ledge at the top,—the base of the cone—on this ledge is placed a covering which, by being screwed on a leathern washer, may be hermetically closed. There are two holes in this cover, one for the air tap, the other for an Indian-rubber tube, which conducts the clarifying syrup to the mould from a reservoir above submitted to the pressure of one atmosphere. Under the influence of this pressure the passage of the syrup through the loaf is very

rapid, and the operation of clarifying only requires six hours at most. To accelerate the process of draining the loaves, for the ordinary "succettes," a current of compressed air from a reservoir is substituted—the pressure of *aspiration*. By a peculiar contrivance the air reaches the mould by the same passage as that by which the syrup was conveyed. Considerable pressure may be applied. The patent includes the provision of a steam-guage and a safety valve.

☞ "The Sugar Industry of Java," by J. Millard, Esq., will be continued in our next Number.

The Report of the Commissioners on the subject of Distillery Lees in British Guiana has been received, with thanks.—*Ed. S.C.*

STOCKS OF RAW SUGAR IN THE CHIEF MARKETS OF THE WORLD, IN THOUSANDS OF TONS, TO OCTOBER 31.

	1869.	1868.
United Kingdom	132	148
France	66	83
Holland	20	38
Zollverein	21	30
United States	101	55
Cuba	28	33
Total	369	387

CONSUMPTION IN EUROPE AND UNITED STATES, IN THOUSANDS OF TONS, FOR YEAR ENDING OCTOBER 31.

	1868-9.	1867-8.
Europe	1255	1180
United States	410	425
	1665	1605

SUGAR STATISTICS—GREAT BRITAIN.

TO 18TH DEC., 1869. IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.
British West India	8	1	1	3	13	33	89	9	13	44	155	196	101	11	14	48	174	186
British East India	13	5	..	..	18	9	20	7	..	..	28	9	12	6	..	..	18	10
Mauritius	2	..	..	1	4	8	8	1	5	5	19	40	12	1	5	5	23	39
Cuba	10	3	..	7	20	23	17	16	27	58	118	134	13	15	27	62	118	128
Porto Rico, &c. ..	3	2	..	1	6	5	6	13	2	3	23	18	6	13	2	3	23	18
Manilla, &c.	36	8	..	2	46	46	32	20	1	4	56	46	25	23	2	2	51	41
Brazil	..	8	1	3	12	22	1	33	16	16	66	62	2	41	16	17	76	56
Beetroot, &c.	2	1	..	1	4	3	16	5	1	15	36	40	17	4	1	14	35	42
Total, 1869 ..	75	26	3	18	122	148	190	103	64	145	502	546	187	114	66	151	519	519
Total, 1868 ..	76	40	4	29	26decrease		201	105	57	183	44decrease		192	103	59	166	slight decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

During the past month the markets have been firm for most descriptions of raw sugar. A good business has been done, and rather higher prices have been paid for the better classes of goods. Refined sugars have been in good demand at former rates.

Notwithstanding the unprecedented crop of beet-root sugars—100,000 tons above that of 1868—and the probability of a largely increased supply of good sugars from Mauritius, considerable confidence is displayed, and a healthy tone prevails.

The long continuance of the insurrection in Cuba, the source of the supply of so large a proportion of good sugars, no doubt tends to the firmness of the market; and it may be noted that although the deliveries in the United Kingdom to the middle of December do not exceed those of 1868, yet on the Continent of Europe they are considerably in excess. The stocks of refined sugar, as well as of good raw are much reduced, which general deficiency, together with increased consumption, may fairly be set against any over production of beet-root sugars.

☞ *Communications and Advertisements to be addressed to the Editor of "The Sugar Cane," Galt & Co., Publishers, Manchester.*

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☞ The writers alone are responsible for their statements.

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ROUGH NOTES TAKEN ON A FLYING VISIT TO THE NORTHERN DISTRICT OF BRITISH HONDURAS.

(*Continued from page* 31.)

There is another usage that ought to be discontinued, one which tends greatly to the disorganization of the people, inasmuch as it is universally prevalent throughout the colony, and affects all classes of the peasantry: I mean the truck system. At the Christmas season the labourer engages his services for the next ten or twelve months, and obtains three or four months advance of wages, half in cash and half in goods. The goods are charged at rates enormously above the market rates, and he is tempted to take many articles of which he is not absolutely in need. These he hands over to his mistress, and with the money he resorts to the liquor shop, and next morning he rises and finds himself penniless! Reluctant to proceed to the scene of his labours without anything to leave behind for the support of his family, he skulks about, away from his employer's premises and scouts, and engages himself afresh, under a fictitious name, to another employer, receives a second advance, and starts for the mahogany works; but soon he is discovered, overtaken, and brought to condign punishment. If from motives of honesty he proceeds to accomplish his first engagement, he is in the midst of the forest without supplies, save his rations; he is obliged to procure his little necessaries from the shop of the proprietor, who reserves to himself the monopoly of

furnishing these indispensables at very high rates. If sickness attack him, he has no doctor, no medicine, and is often accused of shirking his work from laziness. Dissatisfied and disgusted, he works reluctantly, idles away his time, or absconds, only to be captured and punished ere long. Or, if he persevere and continue till his term expires, he finds himself, what with charges for supplies and absent and sick time, deeply in debt, instead of having saved something for a wet day. Thus disappointed, he fancies he has been overreached and unfairly dealt with, and discontent induces him to resort to dishonest practices by way of retaliation. Extravagant and wasteful habits in the labourers are encouraged, deception and falsehood ensue, the master is defrauded, and a feeling of distrust and want of confidence between employer and employed is the result.

It cannot be denied that there are many labourers who by their honesty and industry have realized a respectable competency, and are content and happy, and have nothing to complain of; and I would not for one moment insinuate dishonourable dealing on the part of the master. It is the foreign element in the population that is principally obnoxious to the charge. And there is not one employer who does not see the iniquity of the system, and its evil tendency, and lament its existence and his inability to abate it. One man cannot effect a reformation in a practice so inveterately grafted in the labour system of the country; but if all would set their faces against it, there is no doubt but that this ruinous species of contract would in time be abolished; and I am happy to say that several proprietors have taken the initiative, and I have every reason to hope that ere long the evil will be entirely eradicated.

But this is not all. There is an iniquitous system practised by the Rancheros upon their own countrymen, the Indians, whom they hire at a low figure, with a small allowance of corn and cocoa-nut oil for rations. The Indian has other wants to supply, in the shape of printed calicoes, estrevillas, mantuas, &c., for clothing of himself, his wife, and family. This the employer supplies at 200 per cent. on the market price, and when he and his servant come

to settle accounts, the latter is invariably found in debt. He remains in the employ to work out the obligation, but the longer he stays the deeper in debt he sinks. He dare not quit, for he is soon hunted out and punished; till, seeing no relief at hand, he flies to a neighbouring ranchero, and offers to work for him if he will assume the debt. The neighbour jumps at the offer, liquidates the demand, and takes over the labourer. Vain expedient! The Indian finds himself equally bound to his new master. Work, work, work is the order of the day; but the debt accumulates, and there is no release. Nay, more—the master eventually dies, the debt is sold and bought with the land as assets of the estate, and the "mozos" transferred to the purchaser as goods and chattels—serfs attached to the soil, and irrevocably doomed to perpetual slavery! Thus imposed upon by his own countrymen, overreached by the mahogany cutters, and despised and contemned by all, is it surprising that he sometimes escapes over the border to his tribe, and instigates them to raids and forays in retaliation and revenge?

"*Injuria compensata!—Jacturam rependere!*"

But to return from this digression. Upon the whole, comparing the other districts which I have visited on former occasions, I have no hesitation in declaring that the country possesses great natural resources and vast capabilities of becoming an important sugar-exporting colony.

Perhaps, as an old planter acquainted with most of the West India Islands and their history, and of some experience in the precarious results of sugar making, I am rendered more cautious and moderate in my opinions, and less sanguine than some parties; still, I have every hope in the future of the colony, and every confidence in her vitality. She is at present in a very critical condition, and is about to undergo a transition from mahogany cutting to sugar making, and requires the most judicious management and care to carry her through the crisis. Mahogany cutting and sugar making are two very different things. The latter cannot be acquired in a day; a regular apprenticeship must be served to learn the art, and long experience is required to make a good

practical planter, the paucity of which article here cannot be denied; hence the anxiety of proprietors respecting the issue.

To promote success, the labour system will have to be altered and remodeled, the general centralization at Belize must be broken up, and the labourers located on the estate, so as to be at hand when required; and small lots must be assigned them as gardens to grow their own provisions, in order gradually to abolish the rations, and substitute weekly cash payments alone for wages earned. And when, instead of the truck passes through private property, and trackless paths through pine ridges in which the unguided traveller frequently loses his way, public roads and highways shall have been opened up to facilitate intercommunication, then little villages and townships will spontaneously spring up within easy distance of the estates, with independent shops, where the labourer can purchase with his own money, or exchange his produce for such salt provisions and other necessaries as he may require, uninfluenced by the monopoly of the employer's "Estore." No more obligation to take the master's supplies at fabulous prices—no more periodical gatherings in Belize to spend the holidays in riot and dissipation; for the labouring population must become a permanent, steady, rural peasantry, and the employers a fixed, resident proprietary.

At the first glance it would appear strange that no memorials of improvement have been left by the former settlers; but on reflection it is not surprising, since the colony can hardly be said to have been settled till very lately. The frequent disputes respecting the boundary lines, notwithstanding the treaties with old Spain, were not settled till about the year 1798, after the last attack of the Spaniards, when they were finally repulsed; and these territorial questions were occasionally revived by the neighbouring republics, that raised themselves on the ashes of the former dynasty, so that there was no feeling of security, and hardly any encouragement to form permanent settlements, by building churches and chapels, and establishing schools, &c. Besides, the old merchants and mahogany cutters never intended to make this a perma-

nent home; they came, running all risks, mainly to make a fortune, and return to their native land to enjoy it. Hence they quitted the country as they found it, without roads or buildings, or public establishments, properly so called, and with scarcely any marks of civilization, leaving the improvements to be made by those who should come after them; and it is but within a very recent period indeed that anything like brick and stone buildings have been erected even in Belize.

Moreover, commerce alone has not the elements necessary to properly colonize and settle a new country. Her fluctuating results, and speculative aspirations, and selfish policy operate as a damper on public spirit and enlarged philanthropic views. It is agriculture, with her peaceful arts, and humanizing influences, and quiet steady progress, that can allure the emigrant and fix him to the soil, and incline him to take an interest in the progress of his adopted country, fostering those sympathies and susceptibilities which tend to produce an enlightened civilization, and contribute to the improvement of a country, and the comfort and happiness of future generations.

If, then, we are now to turn our attention to this first parent of civilization, and appeal to the soil for that steady support which a precarious industry can no longer afford, it behoves us to open our eyes to the necessities of the case, and manfully to meet the difficulties which custom and old prejudices have placed in the way of those improvements and innovations which the change will require, and which all experience has shown to be best calculated to promote the welfare and prosperity of a people.

Unfortunately, these evil days have fallen upon us at a moment when the colony is least able to undergo the ordeal. What with an unliquidated war debt, an empty exchequer, and crotchety legislation, we have been compelled to postpone the building of roads, the repair of gaols, the restoration and construction of public buildings, &c.; but these things must be done.

What suited the reign of King Log will not answer the system of the plebian reed; the lax discipline of the lignin system is antagonistic to the rigorous precision of the Concrete process; and

if we wish to conquer, we must adopt those measures which have succeeded so well elsewhere.

It is, then, but a question of time when British Honduras will be able to overcome her difficulties, and know how best to counteract opposition and surmount obstacles; for her advantages are proverbial and patent to every one acquainted with the place.

The salubrity of her climate, where no severe endemics prevail and epidemics seldom reach, where no violent contentions of the elements, no abnormal phenomena manifest themselves to disturb the equability of the temperature or the uniform serenity of the atmosphere, where, situated out of the track of the hurricane and the cyclone, no severe tempests or thunderstorms occur, no overwhelming deluge or dessicating droughts appear, nor sweeping whirlwinds nor devastating earthquakes visit. Her extensive forests and undeveloped tracts of land, affording unlimited scope for enlarged cultivation and improved tillage, her numerous rivers and streams intersecting the country throughout, facilitating the construction of water-power, and the conveyance of produce to the local markets and to the shipping ports, her virgin soil, rich in soluble salts and organic matter, and her varied and diversified subsoil, abounding in all the ingredients necessary to maintain a continued succession of identical crops, all these advantages, taken together, lead to unbounded, unreserved confidence in her future progress and prosperity.

All that is wanting is capital and population: capital to settle down and occupy the land, and population to supply the fields with skilled labour, and the works with experienced hands, public roads throughout the country, and more direct communication with the neighbouring sister colonies; whence we might learn something from their experience, and take a lesson from their successes and their failures, their prosperity and their decadence. With these examples before us, and with prudent and judicious management, there is every reason to hope for, and to look forward to, a bright future for British Honduras.

But the great question is, will she be able to produce sugar as cheaply as the older colonies? In the Antilles the wage is one

shilling a day, cash, with provision grounds; here it is now, eight to fifteen dollars per month, "half and half," with rations, worth about five dollars more; so that, unless the yield be greater in proportion, to counterbalance the difference in the cost of production, the whole affair may after all collapse and fail; and then British Honduras will be nowhere, for mahogany is nearly played out, and there is nothing else to fall back upon but sugar.

But where are the labourers to come from?—Where? The Chinese immigration is a failure. The reception accorded to certain families who came from Barbadoes in 1865 was such as to deter others from migrating thence, and has almost ruined the character of the colony amongst the islands. The Americans that have hitherto come are not exactly the class of people we require. Those with capital are certainly welcome, but the lower orders are not able to work in the fields, under a tropical sun, and they do not understand our system of sugar cultivation, and we have not yet got to the period of the plough age; and the route to Jamaica being closed, I again inquire, whence are the labourers to come?

The opening of the railway in Spanish Honduras must inevitably attract a large number of our hands. Already some forty have signed in Belize for the river Ulua, and some sixty-five Caribs have left Stan Creek for the same place, common labourers at a dollar per day, and artizans much more; and others are waiting only to hear how these succeed, ere they take up their beds and follow. Fortunately for local employers, they had already secured their hands in the Christmas holidays; but I question very much whether next year they will be able to procure one-half the number they now have, at any price!

Notwithstanding all these untoward circumstances, there is still a little gleam of light peeping through the gloom of the horizon; for the constructing of a railway in our immediate neighbourhood may incidentally import new life into our languishing commerce, and the important movements now going on in Cuba, significant of the probable abolition of slavery throughout the world, and the possible advent of free sugar, and free immigration from Africa, may create a great revolution in the state of things; so that a new

era is dawning upon the nations, a new vista of encouragement and faith opening up before us, indicating that a good time is coming, and we must only wait a little longer, and revealing and unfolding a bright and cheering prospect beaming in the distance, in the benefits of which British Honduras must, doubtless, eventually participate.

METEOROLOGICAL NOTES.

DATE.	THERMOMETER.			BAROMETER.		
	MAX.	MIN.	MEAN.	MAX.	MIN.	MEAN.
February 7.	79·00	70·00	74·75	30·110	30·101	30·105
,, 8.	82·00	73·00	78·60	30·090	30·000	30·054
,, 9.	85·00	74·00	80·66	30·050	30·000	30·030
,, 10.	74·00	72·00	73·00	30·050	30·063	30·045
,, 11.	84·00	70·00	79·00	30·050	29·970	30·020
,, 12.	79·00	72·00	75·50	30·000	29·970	29·980
,, 13.	81·00	80·00	80·50	29·970	29·950	29·960

RAIN FALL AT BELIZE, BRITISH HONDURAS FOR THE YEARS FOLLOWING:—

MONTHS.	1862.	1863.	1864.	1865.	1866.	1867.	1868.
January ..	....	1·69	7·28	5·31	7·20	6·77	8·47
February..	....	1·10	2·01	0·41	5·45	3·32	6·61
March....	....	4·22	2·05	2·10	0·95	0·40	0·34
April	....	0·22	3·69	0·19	[illegible]·67	1·57	2·52
May......	....	1·18	0·90	1·11	0·44	0·28	0·37
June.....	....	1·34	10·65	4·05	7·88	10·93	3·54
July......	....	4·02	6·51	15·67	8·01	5·97	2·20
August...	4·69	2·95	13·01	8·88	6·00	8·38	7·23
September.	7·40	5·32	6·34	8·59	5·63	9·28	7·37
October ..	14·97	11·20	9·65	15·54	12·53	18·28	10·23
November.	5·23	14·90	5·32	7·14	4·96	10·04	8·68
December .	5·07	5·06	10·61	6·09	6·70	13·62	2·44
TOTAL....	37·36	53·20	78·02	75·08	67·92	88·84	60·00
Mean per Month.	7·47	4·43	6·50	6·26	5·66	7·40	5·00

ANALYSES

Of three samples of the soil at Seven Hills (taken respectively one foot, two feet, and three feet, from the surface) by Professor Redwood, of the Pharmaceutical Society, London.

	Specimens.		
	No. 1.	No. 2.	No. 3.
Silicates—mostly insoluble	69·2	70·1	71·0
Alumina and oxides of Iron and Manganese.	8·8	12·4	12·6
Carbonates of Lime and Magnesia	5·6	4·4	5·0
Phosphoric Acid combined with Lime, Iron and Alumina	7·6	8·4	7·1
Soluble Chlorides and Sulphate, containing Soda and Potash	0·7	0·5	0·5
Organic Volatile Matter	8·1	4·2	3·8
	100·0	100·0	100·0
Water absorbed by 100 parts of the dry soil in 24 hours	5·5	6·0	6·5

The three samples representing the three strata resemble each other pretty closely. No. 1 contains the largest amount of organic matters. It is also rather the richest in soluble salts containing the alkalies. Nos. 2 and 3 are richest in alumina and oxide of iron, and on this account are more absorbent of water than the other.

The general composition of the soil is good, and especially for the growth of plants like the sugar-cane that abound in silica. The principal deficiency appears to be in the soluble salts of potash and soda.

The following analyses of soils (page 70) is given by the author of the paper for comparison with the above. It may also be interesting to the reader to refer to the analyses of cane soils of Antigua (Dr. R. Angus Smith), in the first number of "*The Sugar Cane*."—ED. *S. C.*

ANALYSES
Of Soils of three different degrees of fertility,
by Professor J. F. Johnson.

	Fertile without Manure.	Fertile with Manure.	Very Barren.
Silica	64·8	83·2	77·8
Alumina (the base of clay)	5·7	5·1	9·1
Lime	5·9	1·8	0·4
Phosphoric Acid	0·4	0·2	..
Potash	0·2	..	..
Organic matter	9·7	5·0	4·0
Oxide of Iron	6·1	3·1	8·1
Oxide of Manganese	0·1	0·3	0·1
Soda	0·4	..	..
Chlorine	0·2	..	..
Sulphuric Acid	0·2	0·1	..
Carbonic Acid	4·0	0·4	..
Magnesia	0·9	0·8	0·1
Loss during the Analysis	1·4	..	0·4
	100·0	100·0	100·0

ON A NEW STEP IN THE PROXIMATE ANALYSIS OF SACCHARINE MATTERS.

By Dr. James Apjohn,

Professor of Chemistry and Mineralogy in the University of Dublin.

The proximate analysis of crude sugars and syrups is a problem of practical importance, and also one of considerable difficulty, as such generally include not only cane sugar, but, in addition, two other varieties of saccharine matter, viz., inverted sugar, and crystallized glucose, commonly called grape sugar. The amount,

indeed, of the cane sugar admits, as is well known, of being readily determined by an optical method, in which we may employ Soleil's saccharometer, the previous saccharometer of Biot, or the much more sensitive instrument for which the scientific world is indebted to Professor Jellett. By taking with one or the other of these instruments the rotative power on plane polarized light of the saccharine material under consideration, both before and after it has been inverted by digestion with an acid, we obtain data from which, and certain constants, the required information may be deduced. If, for example, separate solutions of the three sugars already named be made, containing 416 grains in ten cubic inches, the rotative powers of a column of each 20 centimeters (7·87 inches) long, when measured on the French instrument (with the use of which I am most familiar) are known to be—

For cane sugar..........	100°
,, inverted sugar	— 36° at 59°
,, grape sugar	76°

The rotative powers, therefore, of a single grain of each sugar made into syrup having the bulk already mentioned, and observed in the same tube, will be—

Cane sugar	0·240
Inverted sugar	0·086
Grape sugar	0·182

Hence, the observed rotation before inversion being θ, and after inversion θ', and x, representing the quantity of cane sugar, y, of inverted sugar, z, of grape sugar, we arrive at the two following equations, in which it will be noted that the rotation produced by the inverted sugar has a negative sign, and that the coefficient of inversion of the cane sugar is 0·36 (Jellett) at 59° Fahrenheit.

$$x \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta \qquad (1)$$
$$- x \times 0{\cdot}24 \times 0{\cdot}36 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta' \qquad (2)$$

And subtracting the second of these equations from the first we get—

$$x \times 0{\cdot}24 + x \times 0{\cdot}086 = \theta - \theta'$$
$$x = \frac{\theta - \theta'}{0{\cdot}326} \qquad (3)$$

Very important information is thus rapidly obtained, for the most

valuable constituent of any crude saccharine substance is the cane sugar which it includes. But the analysis is imperfect, for we do not learn from it the quantity of either of the two other sugars, nor even their aggregate amount, for this cannot be got by subtracting the cane sugar already determined from 416 grains, as much of the difference is water, and in many cases *its* estimation cannot be accurately effected by any process of drying.

And here it may be observed, that by chemistry alone, and without any assistance from optical science, we can advance a step further than the saccharometer conducts us. We can, for example, reduce Barreswill's solution of copper with a syrup both before and after inversion. The latter experiment gives us the entire of the three sugars; the former, the sum of two of them, the inverted and grape sugar, while the difference of the results of the two experiments will correspond to the cane sugar. The chemical then goes a little beyond the optical method, for it not only tells us how much cane sugar is present, but, in addition, informs us of the exact aggregate amount of the two other sugars. Further than this it does not go, and we are still unable to assign the exact quantities of inverted and of grape sugar which may be present.

I have now to mention that, in conversing with Professor Jellett on this subject, he threw out the observation that, by combining the chemical and optical methods of experiment, the difficulty just alluded to might possibly be overcome, and the analysis rendered complete. Attaching much importance to his opinion on such a question, I turned the matter carefully in my mind, and soon found that his suggestion was quite correct, as will appear from the following explanation:—

By the optical method already adverted to, and with which physicists are long familiar, we obtain the quantity of the cane sugar; and by *inverting* the syrup, and applying to it the Barreswill's solution, we can get the entire amount of the three sugars, each being estimated on the hypothesis (we shall say) of its being grape sugar. The equations derivable from these two experiments are—

$$x \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta \qquad (a)$$
$$x \times 1{\cdot}16 + y \times 1{\cdot}1 + z = w, \qquad (b)$$

the first being the equation, already explained, which gives the rotative power of the syrup; the second, that which expresses the amount, w, of the three sugars, which, after *inversion*, has been estimated by the *blue solution*. The numerical coefficients in the former equation are, as previously stated, the unit *rotation* powers of the respective sugars, while, in the latter, 1·16 is the ratio of the half atomic weight of cane sugar to that of the atom of grape sugar; and 1·1 is the ratio of the atomic weight of *inverted* to that of grape sugar. Now, as by the optical experiment the amount of the cane sugar, x, has been determined, the first term in each of the equations is known, so that, as there are now only two unknown quantities, y and z, the value of each may be determined.

I have applied this method, on several occasions, in the proximate analysis of crude sugars and syrups, and with satisfactory results. The details of a single experiment recently made will be sufficient here. In operating on the variety of molasses called *golden syrup*, its *rotative* powers, as given by Soleil's instrument, were found to be as follows:

Before inversion .... 38°·35
After inversion..... ......—12°·15

Results from which we find by equation (3) already given, the quantity of cane sugar in 416 parts of the syrup to be 154·95 grains. The second, or chemical experiment, was then made, which consisted in *inverting* 34·3 grains of same syrup, and operating upon it with Barreswill's solution, which showed that the 34·3 grains included 24·75 grains of saccharine matter estimated as grape sugar, corresponding to 297·26 grains from 416 of the syrup. Replacing then x, in equations *(a)* and *(b)* by its value, 154·9, and substituting in them 38·35 for θ, and 154·9 for w, they become—

$$154{\cdot}9 \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = 38{\cdot}35 \qquad (a)$$
$$154{\cdot}9 \times 1{\cdot}16 + y \times 1{\cdot}1 + z = 297{\cdot}26 \qquad (b)$$

These equations involve only two unknown quantities, and therefore admit of solution, and when worked out we find—

$$y = 70{\cdot}66$$
$$z = 39{\cdot}89$$

so that the final numbers at which we arrive are the following, the figures in column (1) referring to 416 grains of the syrup, and those in column (2) being percentages.

	(1)	(2)
Cane sugar	154·95	37·17
Inverted sugar	70·63	16·95
Grape sugar	39·87	9·57
Water and other inactive matters..	150·55	36·31
	416·	100·

The 36·31 parts set down as water are got by difference. I may, however, observe, that by the direct process of drying in vacuo over oil of vitrol only 22 per cent. could be obtained, so that it is possible that some gummy matter may be present. Its amount cannot exceed 14·31 per cent., and it is probably much less, as the perfect expulsion of moisture from syrup is, as already observed, a thing very difficult of accomplishment.

I must not close this short paper without stating that the optical observation which gives θ' is one which it is difficult to make with the necessary degree of precision, for though the syrup may be clarified by animal charcoal, in the process of inversion it invariably acquires a greater or less degree of colour. Fortunately, however, it is not necessary to make any optical experiment on the inverted syrup, for the object of such experiment is to enable us to calculate the amount of the cane sugar, and this can be done in a different way. It is, in fact, quite sufficient, as already explained, to apply Barreswill's solution, not only after inversion but before it, and the difference of the two results will correspond to the cane sugar present in the syrup. The equations which express the results of these two experiments are the following:—

Before inversion, $y \times 1{\cdot}1 + z = w'$, (m)

w' being the grape sugar corresponding to y and z.

After inversion, $x \times 1{\cdot}16 + y \times 1{\cdot}1 + z = w$, (n)

w being grape sugar corresponding to x, to y, and to z.

From which we deduce—

$$x = \frac{w - w'}{1 \cdot 16}.$$

In working upon this plan with 100 grains of the specimen of molasses already mentioned, the following results were obtained:—

$$w' = 30 \cdot 64. \qquad w = 72 \cdot 87.$$

From which *data* we find—

$$x = \frac{72 \cdot 87 - 30 \cdot 64}{1 \cdot 16} = 36 \cdot 44,$$

a number approximating closely to 37·17, the percentage of cane sugar as determined by the saccharometer.

From equation *(m)*, too, we learn that the inverted sugar multiplied by 1·1, with the addition of the grape sugar, amounts to 30·64 grains. But by the conjoint aid of the saccharometer and the blue solution, it has been already shown that $y = 16 \cdot 95$, and that $z = 9 \cdot 57$, so that $y \times 1 \cdot 1 + z = 28 \cdot 21$.

There is manifested here, it must be admitted, an appreciable amount of divergence, for instead of the chemical and optico-chemical methods of assay being in harmony with each other, we find that a result given by the former exceeds the corresponding one given by the latter, by 2·43 per cent. The cause of this discrepancy it is not difficult to assign. It must obviously proceed from the presence in the molasses of some principle or principles different from either cane, inverted, or grape sugar, and which themselves exercise circular polarization, and, mayhap, also exert a reducing action on Barreswill's blue solution. The substances of this nature, which may possibly be associated with the sugars in saccharine juices, are dextrin, asparagin, and tartaric acids; and when any such do exist in a saccharine product, its *exact* proximate analysis is rendered extremely difficult, if not impracticable. It is, therefore, scarcely necessary for me to state here that the optico-chemical process explained by me in this paper, will only give perfectly accurate results when applied to a mixture of cane, inverted, and grape sugars, in which no other *active* principle is

contained. I may, however, add that the sugars just enumerated constitute the great bulk of all known saccharine products, and that, when other matters are present which complicate the problem, they are usually in such minute quantity as not to interfere materially with the success of my method, when applied generally to the proximate analysis of saccharine products.

THE SUGAR INDUSTRY OF JAVA.

BY J. MILLARD, ESQ.

(*Continued from Vol. I, page* 279.)

APPEAL is sometimes made to the results of private undertakings in Java, to show that the changing of cane fields is not absolutely necessary; but in general the results obtained will not bear comparison with the Government sugar cultivation, and where they do, it will be found that the fields really are changed by a rotation of crops. Beside, in cases where the cultivation *is* continued, planting afresh between the old rows is resorted to, and rarely is more than a second or third crop obtained, and then only by expensive manuring.

Mr. Lebrit, who obtained such good results at Kadawoeng, states that his fields were planted with cane only once in three years, and Mr. Krajenbrink's experience is also worth attention. "Planting in rows five feet apart, I obtained from the first crop 60 to 65 picols per bouw—40 to 43 cwts. per acre; but it was soon apparent that this could only be obtained by the first planting on fertile land of light loamy character: on heavy alluvial soils, where the silicates are present in different forms, and those less suited for assimilation, the cane did not thrive so well, and the ratoons caused disappointment."

It is more than probable that the example of other tropical countries, where the sugar cane is grown for years consecutively on the same soil, excites the wish to follow the same plan or custom in Java. But the geological formation of the sugar

growing countries ought not to be lost sight of, any more than the climatic influence. One of the earliest writers on the cultivation and manufacture of sugar (L. Wray) informs us that in some of the West India Islands—as in Cuba, Guadaloupe, and Jamaica—the sugar cane, planted on virgin soil, may be cultivated for 20 to 24 years, but that it is not usually done beyond from 3 to 7 years; and that if the first planting yields two tons per acre, the next does not produce more than a ton and a half per acre. Further, that in India he has never seen good ratoons, and that time, money, and labour are spent without any profitable result; so that there, in his opinion, the yearly planting of the cane fields ought to be adopted without hesitation.

This writer comes to the conclusion that in general at most two successive crops can with any profit be drawn from the same ground, a result that quite agrees with the observation of one of the most recent writers on the rural economy of India (Lieut-Col. Greenaway), that a third crop on the same soil causes deterioration in the cane.

The general rule says Porter, is to plant a certain part of the fields, mostly a third, in yearly succession with cane; in the newer colonies and richer grounds of the old, it is continued for twenty years, though frequently the planting is renewed every six or seven years, and on poorer soils every two or three years. The writer of "L'exploitation des sucreries" has made a comparison between the expense of the plant canes and ratoons to the advantage of the latter of $\frac{2}{3}$ less manure, $\frac{2}{3}$ less labour, and $\frac{1}{6}$ less risk, but on the other hand to their disadvantage, smaller yield.

The island of Mauritius has been frequently instanced as showing productive strength of soil; but there, also, experience has proved that withholding sufficient rest from the cane fields, and neglecting the manuring of them with guano, not merely impoverishes the soil from year to year, and diminishes the yield, but also induces the disease in the canes which has latterly become so alarming, and even, according to Dr. Icery, deteriorates the quality of the juice; so that frequent changing of the cane fields [rotation of crops] has come to be considered as absolutely

necessary, and is being more and more adopted. Thus, according to an advice of last year, the more energetic planters who have already carried out this plan, have obtained magnificent canes, perfectly free from insects and disease, and they have utilised these old fields by planting them with shrubs, which promise good profits.

Generally, in the comparison between the yields of the sugar cane in other colonies, and the duration of the plantings, the important difference which exists in the productions of the first and the following crops from the same ground without fresh planting is not considered. A short account therefore (so far as it is possible to collect correct data) may serve to confirm what has been advanced, and to explain the small results of a second successive cane crop in Java.

La Réunion is said sometimes to have produced from plant canes, 10,500 kilogrammes per hectare (4 tons per acre) generally 8,400 kilos. (3¼ tons per acre); but by the smaller yield of the subsequent crops the average declined to 3,500 kilos. per hectare (1·4 tons per acre).

Mauritius, says Porter, is able to produce from maiden soil in the first year, 5,000 lbs. avoir. per acre; but even in the second year the crop from the same ground yields considerably less, and after several successive harvests the yield of the ratoons declines to 1,100 or 1,200 lbs. per acre.

One account more, from a good source,* may serve for comparison. In Guadaloupe the average yield of the sugar cane is thus fixed:—

1st crop	(plant canes)	..........45,000 to 70,000 kilos. 1¾ tons to 2¾ tons per acre.
2nd ,,	(1st ratoon)	..........20,000 to 45,000 kilos. 1¼ tons to 1¾ tons per acre.
3rd ,,	(2nd ,,)	..........20,000 to 30,000 kilos. 17 cwt. to 1¼ tons per acre.

After which the crops continue far below mediocrity.

* *Journal des Fabricants de Sucre*, 1864, No. 4.

Van Vloten says:—"Experience has hitherto taught that even in the most fertile parts of the island of Java a second crop cannot be obtained, except of an insignificant character. This is, doubtless, a decided disadvantage, for a saving of not less than half of the labour of the sugar cultivation in the whole of Java is thereby at stake. The primitive causes of this being unknown, the importance of the matter deserves to be made a subject of careful and deliberate inquiry by the Indian Government, for which the means, scientific as well as practical, are not wanting."

If a theorist warn us, with earnestness and intelligent arguments, that, even with changing of the cane fields, virgin soils themselves, after a certain number of harvests without manuring, become at last unfertile, how much more do the words of the experienced Krajenbrink deserve attention:—"If the facts of practical agriculture point towards a slow, but inevitable exhaustion of the soil, wherever the same land is planted every year, science does not warn against it the less. Whoever understands the language of chemistry, and has the patience to read the volumes of Professor Mulder's last work, 'The Chemistry of Arable Land' (the fruit of a whole life), can there find what awaits him if he neglect the warnings here [in Java] only whispered, but which in Mauritius are spoken in a louder voice."

There is another difficulty not to be considered too lightly in connection with the question of the changing of cane fields, and that is the distribution of rain, in relation to the planting and the grinding season in Java. The difference, in this respect, of the circumstances existing in other places must not be lost sight of.

In many sugar growing countries, where two wet and two dry seasons prevail, there are frequently two periods of planting, one in the spring and one in the fall of the year; so that not only can planting be done nearly throughout the whole year, but, consequently, the grinding season is not necessarily confined to any fixed time.

Experience teaches how dependent the planting of the cane is on the occurrence of the monsoons in Java, and that it must be

done from July to September, not only because the rice harvest does not permit any earlier disposal of the fields to prepare them for the cane planting, but that the grinding of the cane [being dependent on the planting] would be exposed to unfavourable weather. Later than October the grinding must not last, and as the contractor begins to cut the cane in the month of June, the same ground cannot be worked, aired, and planted *in time* for a second crop, certainly not that part of the land from which the cane is only carried to the mills during July, August, and September.

It is scarcely necessary to show that where, in private undertakings, the periods are altered for want of exchange fields, the effect is experienced not only in the cane but in the quality and the quantity of the sugar.

In private establishments it has been impossible to use the black sugar cane, which has become better known within the last five years, and which, in fact, is one of the best kinds, and one to which many manufacturers owe their best results; because they, not having sufficient fields at hand, are consequently obliged to keep two-thirds as ratoons, for which that kind of cane is not so well suited. But the private undertakings in which ratooning is not practised cannot plant nearly the whole extent of their fields, however richly they are manured, just because they would then have no means of changing.

In immediate connection with the changing of fields, it appears to me useful to fix the attention on the theory of exhausting and renovating cultures. Without wishing to enter too deeply into it, I will nevertheless briefly remark that according to this theory proved by practice, certain cultures prepare the land for finer crops, others exhaust it; the most nutritive plants are reckoned chiefly among the former. To a certain point all plants are averse to returning to the same soil that has produced them: only on soils of exceptional fertility can the cultivation be repeated, even of those crops that, as a rule, improve the soil, without lessening the production.

Hence arises the necessity of a proper choice of plants, for a

rotation of crops which shall improve the soil. In the Antilles it has been found that the manioc does not exhaust or waste the soil, but rather enables it to produce a finer crop of sugar in the next year. The plants of marshy soils, or those which require flooding, contribute to the improvement of the soil. Hence the advantages of the Java rice fields.

In connection with this question, I may draw attention to the astonishing, and in many respects alarming, theory lately put forth by the celebrated Dubrunfaut, viz., that agriculture has no means of increasing the harvest, without deteriorating the quality of the produce.

Dubrunfaut asserts that in Germany, where the culture of the beet-root is not forced, and the harvest seldom yields more than 25,000 to 30,000 kilos. per bunder (10 to 12 tons per acre), with little manuring, the yield of juice rises to 8 per cent., and in Russia, where absolutely no manure is used, to 9½ and even 10 per cent., the beet-root fields producing only 16,000 kilos. per bunder (6 tons per acre); while in France, though the harvest amounts to 50,000 and 60,000 kilos. per bunder (20 to 24 tons per acre), the yield of juice is seldom more than 5 per cent.

This appears to militate against that forced cultivation on which attention is just at present more and more fixed. If that theory were to be confirmed (fortunately, it is often contradicted), what an incalculable influence the result would have, not simply from a hygienic point of view, but also upon the economical condition of nations. But I will venture the supposition, that as in the theory of population by Malthus, or that of ground-rent by Ricardo, however true it may be in the abstract, a number of circumstances practically modify it and make it harmless.

To acquit myself of partiality, I must observe that in this country [Holland] tobacco is continually planted on the same land, but with rich manuring, and that in Ceylon, coffee plantations are never allowed to rest. Whether or not, at the expense of the quality in both cases, I am unable to state.

The important experiments in agricultural chemistry which are being made at Vincennes, with regard to manuring, under the

direction of the celebrated M. Ville, will probably throw more light on this subject, of which our manufacturers in Java will be able to take advantage. But at present the strife between the men of science continues, and practice in Java at least, has given no satisfactory results for the sugar cane without the changing of fields. Let us hope that science and practice will soon decide whether, in case the sugar cultivation in Java is neither to decrease nor to degenerate, the exchanging of the fields, and a sufficient extent of land for it, will be indispensable. When experience and the knowledge of agriculture shall have pointed out the way to escape from the disadvantages of an uninterrupted growth of the sugar cane, doubtless, every contractor will gladly take it, for from a pecuniary point of view, the changing of fields, now necessary, is not favourable to his interests. Surely any one can conceive that if it were possible to render constant the same productive power on a given surface, a great number of exchange fields, as well as labour and wages, would be saved, and the making and maintaining of roads for conveyance would be much easier.

After having shown the productive power of the soil for the growth of the sugar cane, I wish, in a few words, to make a comparison with the value which an equal area yields, planted with other produce. I shall only mention the two crops which are the most important to the native, viz., coffee and rice.

If I fix the yield of coffee at six picols per bouw, 4·16 cwts. per acre, and a high market price of 40 guilders per picol, (about 55s. per cwt.,) a yearly value of about £11 10s. is obtained. Even if the production of coffee, which, it is said, Ceylon yields (nearly 7 cwts. per acre), is assumed at the same price, it then represents £19 per acre yearly. With this let it be remembered how long a time the tree will require before it yields fruit.

As regards the cultivation of rice. Suppose a particularly good harvest of 40 picols of paddy, which at a market price of 3 guilders makes 120 guilders, add to it for a second crop 50 guilders, then there is obtained yearly only 170 guilders (about £12 per acre).

In comparison with this I place only an average production of

sugar of 45 picols per bouw, and a market price of 15 guilders per picol, then a value of 540 guilders (£38 per acre) is obtained in the same period of a year; for, not to be partial I must observe also that for this crop the ground is in use fifteen months on an average. But against those very high yields of coffee and rice, a better yield of sugar may also be placed.

With regard to the division of this value, the net yield, or the surplus, we shall have opportunity of further consideration; at this moment my aim is only to show the difference in the value of the materials generally.

Therefore, I will at present say as little of the labour and expenses bestowed on those materials, nor need I observe how the yield differs in proportion to the productiveness of the soil.

Neither may the advantages be overlooked, which arise from the traffic of a hundred manufactories, apart from the wages for planting, bringing into circulation about ten millions of guilders in wages, and different objects, even though those sums are distributed more among the natives than the planters.

If, in Europe, communities value on account of the traffic, exhibitions, universities, garrisons, courts, and other things which I should not always dare call productive, the presence of a number of useful manufactories cannot be a matter of indifference to the general prosperity, if, at least, they rest on good basis.

There still remains an important question, viz., whether Java in another respect will be able to maintain the competition against the sister industry of the beet root, and the sugar production of other colonies; a purely economical question, and that is the cost of production.

On this I shall dwell as briefly as is consistent with a complete explanation.

Estimating the costs of manufacture is certainly not free from difficulty, as they are dependent on local circumstances, on large or smaller yields, and other things.

Those of Java we know, and how they vary, according to circumstances: at the present time, and with the enhanced costs,

	s.	d.	
they cannot be calculated at less than	12	6	per cwt.
To this must be added:			
8 per cent. interest on capital of 350,000 guilders,			
5 ,, sinking fund,			
5 ,, dividend,			
18 per cent. = 63·000 guilders or £5250 distributed over an average production of 30 cwts. per acre	5	0	,,
Actual cost of production..	17	6	per cwt.

A very considerable outlay must be added to that to bring the Java sugars into the European markets. The exact figures are, of course, dependent on the changing prices of freight, insurance, commission, and other things. From the official reports it appears that in the last five years the Government paid for these about 7s. 9d. per cwt. Because the Government charges for freight are higher than those of private firms (independent, however of the height of freight charges and the course of exchange), the ordinary costs, founded on the accounts of different commercial firms in the Netherlands that I have consulted, may be fixed in round numbers at about 6s. 4d. per cwt.

The Java picol yields at the most 57 kilos. In a sound state of things the course of exchange will always be above par; so that, with that in view, in the Netherlands 100 kilos. of sugar will cost 51s. to 52s. (26s. per cwt.) After subtraction of the highest and lowest prices for this Java sugar, the average price has been, since 1842, 30s. per cwt. This price, however, can be generally obtained by the Netherlands Trading Merchant Company, in consequence of the very great facilities which they offer the buyer, which the private firm cannot do. Therefore, frequently after the auctions of the company, the private price is immediately noted from 1f. to 2f. lower; so that that auction price has to be reduced at least 1f., and thus reduced

to the average of 28s. 6d., with the charges at 26s. per cwt., a difference of about 2s. 6d. per cwt., reckoning, however, only a cost of production of 18s. per cwt. in Java, without any merchant's profit but the commission; so that, according to that calculation, not more than 20s. per cwt. could in the long run be paid in Java.

I need scarcely make the remark that at present only the costs of the sugar industry by itself are spoken of: the high requirements of the Government, which have a preponderating influence on the results, are left out of the account; but these will subsequently be spoken of. On that account, the interest on capital, the profits of the undertaking, and the sinking fund, are spread over the whole average production of 18,000 picols from 400 bouws [about 1,000 tons from 700 acres].

I do not think this a fitting occasion to enlarge on the results of the private sugar industry; firstly, because its economical position is such that its results can furnish no standard of comparison; and, secondly, because I do not wish to anticipate the deliberations on the following points.

In the cost of manufacture in foreign colonies there are great fluctuations, and it is not possible to take a fair average, therefore the inquiry as to that cost is of less moment. In Barbadoes it was fixed some time ago at about 7s. 6d. per cwt.; in Trinidad at 13s. 4d.; in Jamaica at 11s.; and in Demerara at 12s. 6d. In Mauritius the cost of production was reckoned lower; but in latter times the cost of immigration swallows up much money. Emancipation has brought about a great change in the economical condition, and oppresses with a heavy burden of debt, landed property of the plantations of Martinique, Guadaloupe, and Réunion.

Formerly, according to official reports, the cost of production in the French colonies was reckoned at 60f. per 100 kilos. (24s. per cwt.) Probably it will be safest to place confidence in the declaration of the French statesman, Thiers, made in the legislative assembly of 1864, that the cost price in the French colonies amounts to 42f. per 100 kilos. (17s. per cwt.)

It is to be observed here that the French law in the interest of the colonies, till lately, allowed a drawback *(dé taxe)* of 5f. per 100 kilos on sugars imported from them into France.

Taking into consideration the lower value of the French colonial sugar, no competition from that quarter is to be feared.

But the competition of the beetroot sugar is felt, and it is of preponderating importance to know the cost of its production. In it, however, there is this difference; that it depends chiefly on the cost of the beet-roots and it is undeniable that the price of them is constantly rising. Some years ago 10s. 6d. was paid for a ton. In 1856 the price rose to 13s. A constant decline in that price was thought probable from improved cultivation. This prediction has not been verified. On the contrary, it is acknowledged that such a price is too low for the agriculturist, and the manufacturer should not look for a lower price than 14s. 6d.

On the other hand, it appears rather extraordinary that some manufacturers can pay 16s. to 17s. 6d., which it is almost impossible for them to realize. Notwithstanding, two years ago, that price had to be given, and there are instances in which Dutch beet-root sugar manufacturers have paid 25s. per ton.

(To be continued).

PRACTICAL INSTRUCTIONS FOR THE APPLICATION OF THE MONO-SULPHITE OF LIME PROCESS.

BY DR. E. ICERY.

[From the French.]

THIS process consists in a special method of preparing the sulphite of lime, and of applying it to the decoloration and purification of cane juice and syrups.

The necessary conditions for the proper utilization of this process are comprised in two species of operations: the one connected with

the fabrication of the substance itself—the other with the method of using it.

PREPARATION OF THE MONO-SULPHITE OF LIME.

Mono-sulphite of lime (insoluble sulphite of lime, proto-sulphite of lime) is so susceptible of a modification which renders it but slightly sensitive to the action of feeble acids contained in a large mass of liquid, as to need to be manufactured at the very moment of its use, and in a peculiar manner.

On this method of its preparation, the success of its application to cane juice and syrups depends.

It is consequently important that attention should be paid to the rules which I am about to lay down, and which, happily, can be easily and expeditiously carried out. But before making them known, it will be needful to say a few words on the working of the apparatus which has been constructed for manufacturing this substance in the *usine* itself, and as it is required.

This apparatus,* by its strength, its peculiar construction, and

* This apparatus is not exclusively reserved for the application of the process here considered. Designed for the manufacture of sulphurous acid and sulphites, it may serve for application to other methods which are not the object of any special reserve, such, for example, as that which consists in the direct use of sulphurous acid or the solutions of the bi-sulphites, and their transformation into mono-sulphites in the juice itself by the addition of a sufficient quantity of lime before concentrating the juice. These methods, practised at different epochs by Melsens, Stowart, Reynoso, &c., have the disadvantage that they do not act in a precise manner, and they necessitate a *surveillance* which is not always easy to ensure in colonial *usines*. In experienced, hands they are always capable of producing satisfactory results. Thus it may not be out of place to define in a few words the legal right of those who wish to make experiments. Leaving minute shades of difference, three modes of proceeding are open to them. One consists in the direct introduction of sulphurous acid, or a solution more or less concentrated of bi-sulphite, into the juice issuing from the mill, and then to add the lime at a given moment in the process of evaporation. Another is the direct opposite; that is to say, to saturate the juice at *first* with lime, and to introduce the sulphurous acid when the temperature of the juice has been raised to the boiling point. Lastly, the third is to make use of a more or less con-

the perfect regularity of its operation, satisfies as exactly as possible the exigencies and the customs of colonial manufacture.

Producing, by means of the combustion of raw sulphur, a solution always charged with the same quantity of sulphurous acid, it allows of the manufacture on the spot of sulphite of lime, of one uniform strength, of which the cost is thus in proportion to that of the sulphur and the lime of which it is composed, that is to say, an almost insignificant sum.

One ton of sulphite of lime contains 532 *livres* (586 lbs.) of sulphur, and 932 *livres* (1,026 lbs.) of lime; thus the cost, including the manufacture, is so small, as to be less than the freight of the article would be from Europe.

The manufacture of the sulphite of lime in the *usine* itself combines the advantages of utilizing an excellent material heretofore not industrially applied [in Mauritius], of producing it at a low price, and of preventing the planters being dependent on foreign supply.

To put the apparatus in operation, a certain quantity of sulphur, say a pound and a half, is thrown into the furnace, and when in a few minutes the products of combustion are thrown off in abundance by the chimney, a stream of water from a cistern is allowed to flow into it of such volume that the valve placed at the end of the last column being three parts closed, the sulphur continues to burn easily, without the white vapour being perceived to escape by the extremity of the chimney.

By this means nearly the whole of the sulphur is utilized, and is transformed into sulphurous acid, which accumulates in the apparatus, and is dissolved in the fine shower of water which descends slowly in streams towards a cylindrical reservoir fitted with a discharge tap.

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centrated solution of bi-sulphite, in juice rendered alkaline by the introduction of a large proportion of lime.

The sulphurous acid to be employed in these cases is the acid solution furnished by this apparatus. The bi-sulphite of lime, which is, of all the bi-sulphites, the one to which the preference should be given, is prepared by adding to the lime the same sulphurous solution, until the mixture, at first white, then yellow, becomes quite transparent.

To regulate properly the working of the apparatus it is then needful:—

1. To throw from time to time a large handful of pieces of sulphur into the furnace.
2. To provide means for regulating and continuing the flow of water.
3. To open the valve just sufficiently to permit the combustion to go on actively, without the escape of the white vapour by the chimney.

The apparatus being sufficiently charged with the sulphurous solution, proceed as follows:—

The liquid is conducted by a pipe from the reservoir (where a tap is fixed) into the bottom of a circular wooden vessel, an ordinary barrel will do, where a certain quantity of common lime, or, better still, of quick lime finely sifted, has been previously placed.

As soon as the liquid comes in contact with the lime, a circular motion must be given to the barrel, that the acid may be freely mixed with every part of the lime, until the whole is transformed into sulphite. When this transformation is complete will appear by the liquid which is at first of a milky whiteness, becoming of a very decided clear yellow colour.

But it is important (and this is an essential point in the operation) that a little more sulphurous acid be allowed to flow from the reservoir than is needful to saturate the lime; this may be ascertained by dipping into the liquid a slip of blue test paper, which will *then* turn red.

It is not necessary that the yellow fluid formed in the wooden vessel should be very decidedly acid, but unless it were so to a certain extent, the sulphite would not fail to contract some modifications which would render it less able to exercise a proper action on the juice and syrups.

The lime possesses some qualities variable according to the care which has been exercised in its preparation, and it may be difficult, to determine on a uniform quantity to be added to the sulphurous solution to form mono-sulphite.

One prelimiminary experiment easily made will enable the opera-

tor to determine the exact quantity needed. Having allowed sufficient sulphurous acid used for one operation, say 20 gallons, to flow into the wooden vessel, take a certain quantity of the sifted lime, about what is generally used, say two or three pounds weight, and throw this little by little into the liquid, until the acidity of it has nearly disappeared. By weighing the remainder of the lime you may calculate the exact quantity needed for 20 gallons of the sulphurous solution. After this is ascertained, you may prepare a wooden vessel by which you can measure with sufficient accuracy the quantity of lime needed for each operation. When you wish to change the sort of lime you use, the test paper will show whether the quantity must be increased or diminished.

The proof by test paper will be needful in each operation by those who have had no experience in preparing sulphite of lime by this process; because, by its use alone can the requisite degree of acidity of the yellow milky fluid be precisely ascertained, and, as we have already said, one of the essential conditions of the efficient action of sulphite is, that it be kept in a slightly acid liquid up to the moment of its use.

This acidity, too weak to increase in any appreciable degree that of the juice, to which the yellow fluid is only added in the proportions of 2 to 3 per cent., serves to keep insulated and in a state of purity the fine particles of which the powder consists, under the form of which the sulphite of lime has been obtained. It prevents the surface of the particles from undergoing a change into a mixture of sulphate and sub-sulphite, which, covering them like a shell, would render them unfit to submit to the action of weak and diluted acids.

In short, then, it is necessary:—

1. That the sulphite of lime be prepared at the moment of its use.
2. That it be obtained in a very fine powder.
3. That it be kept in the liquid in which it has been formed, in such a condition, that the grains or particles of which it is constituted remain insulated, and in a perfectly pure state.

It is better that the lime used in the preparation of sulphite should have been previously washed, to deprive it of any soluble salts which it may contain in small quantity.

METHOD OF USING IN CANE JUICE.

The mono-sulphite of lime being insoluble, necessitates certain precautions for its effectual application. It is not sufficient to merely mix it with the juice: it is needful to ensure its contact with the saccharine fluid during the greater part of the process of evaporation.

On issuing from the mill, the juice must be quickly deprived of the residues of megass and other débris by a copper sieve, and then left to stand 10 to 15 minutes, to allow of the precipitation of the corpuscles, which the metallic wire cannot separate. To prevent any fermentation during this time, the surface of the juice is sprinkled with the liquid sulphite; this accumulates in the scum, and is found at the bottom of the cistern when the juice has been drawn off.

The juice is then taken to the evaporators, where is added 2 to 3 per cent. (generally 2½ per cent.) of the yellow slightly acid fluid, containing the sulphite of lime in suspension.

By stirring the juice freely, the sulphite of lime (thanks to the state of minute division in which it has been obtained) is quickly diffused through all the liquid mass of saccharine fluid, on which it immediately commences its double action of decoloration and defecation.

Two methods of operating are now presented, according as the juice is sent direct to the battery, or submitted to a preliminary defecation in double-bottomed cisterns heated by steam, to be then concentrated by the battery or the *triple effet* apparatus.

I. In the first case the care chiefly needful is to remove the scum which has accumulated in the two first coppers, and to prevent its mixing with the liquid in the ulterior processes. The surest means of effecting this result is to make use of a large beam of wood, sinking about 20 inches below the surface of the liquid and the length of the division which separates the second from the third copper, and to arrange carefully in the central part of this

beam an opening provided with a sieve, which may be moved in such a manner as only to permit of the passage of the juice when defecated and deprived of its scum.

But there is one particular which cannot be too much insisted on, as on it all the success of the process depends—that is, the reaction of the saccharine juice. It is *essential* that this reaction be kept distinctly acid during all the process of manufacture, not only in the battery, but also when the clear syrup, after sufficient decantation, is concentrated in the vacuum pan, or other apparatus, at a low temperature. The neutralization of this acidity, even momentarily, will inevitably modify the results which this process is designed to realize.

It is nevertheless useless to allow the acidity to become developed beyond a certain degree, because, carried too far, it causes serious difficulties. The blue test paper will here again be of use in showing the exact limits to be observed in this respect. A strip of this paper dipped into the different coppers will constantly show an acidity so much the greater as the juice is nearer cooked, which fact is explained by the concentration of the liquid and the tendency of juice to acidify under the influence of heat. If more lime is not added, the natural acidity of the juice, as it becomes evaporated, passes the degree which it is necessary to maintain.

It will be needful, then, in the fourth or fifth copper (and in that alone), to throw on the surface of the boiling juice some ladlesful of very weak lime water, to lessen the acidity when it has become too great; but great care must be taken to avoid the use of too large a quantity of lime water, because it is important that the acid or acids of the juice should never be neutralized.

To fix the attention on this essential point in the process, we state that the acid reaction to be maintained should be such that the concentrated syrup marking 20° to 22° Baumé should redden the blue test paper with double the intensity which it indicates in the third copper, where again this reaction is more distinctly marked than in the juice first sent to the battery.

By proceeding in this manner, the quantity of sugar inverted, as I have proved by numerous comparative analyses, is very much

less than what is generally produced in other processes, because these are only too often based on false or merely theoretical ideas, and the carrying out of them continues consequently to be incompatible with the resources and the actual wants of the colonial sugar industry.

The concentrated syrup, when sent from the battery, and marking 16° to 22° Baumé, rapidly abandons the solid corpuscles which it contains, and, merely allowed to stand for some hours, becomes decolored and limpid. Then taken to the vacuum pan, it produces a mass of light crystals, differing very little from what are produced by the use of animal charcoal. The facility with which juice submitted to this process crystallizes, necessitates its being boiled rather "lighter" than ordinary. The centrifugal process is effected with ease, and with less water than is generally used to whiten the sugar completely.

II. When cisterns heated with steam are made use of before the juice is sent to the battery, the liquid mono-sulphite of lime, of which only 2 per cent. is used, is introduced directly into the defecators. After it has been intimately mixed with the juice, the defecation, which should last at least a quarter of an hour, is proceeded with; the scum is separated, and the saccharine liquid allowed to flow into the reservoir, when the decantation proceeds.

This being done, the juice is drawn off, there being added to it at the moment when it runs into the battery a fresh quantity of liquid sulphite, to the amount of 1 per cent. The rest of the operation is effected as has been stated above.

III. When the first process of concentration, instead of being performed over the open fire, is conducted in the *triple effet*, the manner of proceeding may be advantageously modified. It is then easy to obtain from the commencement a complete defecation, which simplifies and adds to the utility of the *triple effet*.

In this case the following order is pursued:—

The juice, with only a small proportion of the milky sulphite added, to prevent fermentation, is sent into the steam pans, where it is subjected to the ordinary lime defecation. The lime is added, little by little, in fine powder, and the quantity should be such that,

after the separation of the scum, the juice possesses the same degree of acidity which it had before the addition of the lime. This result is generally obtained by using 6 or 7 ounces of lime to nearly 60 gallons of juice.

The defecation completed, the scum removed, 3 per cent. of the liquid sulphite, which it is well to render rather more acid than when the battery is used, is introduced into the liquid mass. After stirring the whole well several times, it is re-heated for 8 or 10 minutes, when it is allowed to flow into the cistern, and decanted very quickly. The juice thus prepared may be concentrated by the *triple effet* without forming any appreciable deposit.

METHOD OF USE FOR SYRUPS.

The syrups made by centrifugaling the first or second crystals may be treated with the mono-sulphite of lime even more advantageously than the cane juice. Under the influence of this agent, the syrups are purified, decolored, and crystallized with remarkable facility.

The mode of applying the sulphite of lime does not differ from that which has been directed for the juice; the quantity only may be varied according to the degree of decoloration and purification already obtained by the action of the sulphite on the juice. The quantity may vary from 1½ to 5 per cent., for syrups marking 25° Baumé—that is to say, 1½ to 5 gallons of the liquid sulphite to 100 gallons of syrup, diluted with water to the degree most convenient for boiling (25° Baumé).

The syrup should be fresh, and of an acidity very nearly the same as that of the concentrated juice when it leaves the battery. When it is not quite fresh, and has begun to ferment, it will be needful to add lime water before treating it with the sulphite. If, on the contrary, it is only slightly acid, liquid sulphite should be used containing a larger proportion of sulphurous acid.

In short, the aim should be to place the syrup in a similar condition of acidity to that observed for the juice, and to employ a greater quantity of sulphite of lime in proportion as the syrup is more coloured and less purified.

Sugars from syrups treated in this manner are perfectly crystallized, and of good colour. This improvement is not due solely to the direct influence exercised by the substance employed: it is owing in great measure to the purification to which the juice has been subjected, and to the elimination of those foreign soluble salts, which are, as is well known, one of the principal obstacles to the crystallization of syrup sugar.

MEGASS ASH, CANE MANURES, & DISTILLERY LEES.

BY ALEXANDER CRUM EWING.

In an article on Megass, published in *The Sugar Cane* of September, three analyses of cane ash were given, showing, as was remarked, considerable discrepancies. The following is an average of twelve analyses of cane ash, by Dr. Stenhouse:—

Silica	43·2
Phosphoric Acid	6·8
Sulphuric Acid	6·6
Lime	8·4
Magnesia	7·6
Potass	16·6
Chloride of Potassium	4·9
Soda	0·5
Chloride of Sodium	5·4
	100·0

And though it, too, differs in some respects from the others, it very closely approximates the analysis made by Dr. Anderson in the per centage of potass, 16·06, the most important constituent in a manurial point of view. The manager of the estate from which Dr. Anderson got his sample was desired to take it fresh from the stoke-hole, and keep it free from damp; and I should think it

might be taken as fairly representing Demerara Megass ashes. Basing his calculation on this analysis, Dr. Anderson estimates 16 per cent. of potass to be equal to 31lbs. muriate of potass, and the 3·75 of phosphoric acid to be equal to 8·2 of phosphate of lime; so that a mixture to contain equal parts of potass and phosphoric acid would cost (varying with the price of the manures) not less than £3 10s., or if sent from this country we must add for carriage, packages, &c., other £2, which those gentlemen should remember who use Megass ashes for mixing mortar and levelling-up their yards. As these ashes contain the principal part of the mineral constituents of the cane, it is of great importance that they should be returned to the land, being first finely ground, without which their action would be almost imperceptibly slow; and a good way of applying them would be mixed with sulphate of ammonia and phosphate of lime, or with Peruvian guano.

Sulphate of ammonia is the manure most generally applied in Demerara. For stimulating young canes chilled by long continued rains, and for promoting luxuriant growth, probably no better material could be employed; but its general and profuse application is apt to generate rank juice, wasteful of fuel in its evaporation, and producing an inferior sugar; besides, the constant use of ammonia, unaccompanied by those mineral elements necessary to form the cells of the sugar cane, must prove exhaustive to the soil. To prevent this, by the advice of Dr. Anderson, I had a mixture prepared, consisting of 50 per cent. sulphate of ammonia, 25 per cent. phosphate of lime, and 25 per cent. muriate of potass. (Where stoke-hole ashes are used the last ingredient may be omitted, and probably the proportion of phosphate of lime may be increased with advantage). This we have been using in large quantities for some time past, but now, in consequence of the high price of ammonia, which has risen £6 per ton within the last three years, we are trying other manures and endeavouring to do more with what can be made available on the plantations.

The restorative effect of fallows on carse lands is well known in Scotland, and would no doubt produce like good effects where required on similar soils in the West Indies, such as much of the

land in British Guiana. In St. Kitts the planters manure largely with pigeon pea, and other crops ploughed in green; in some parts of Cuba they manure with molasses; in Jamaica they make large quantities of cattle pen manure and mix it with spent wash from the distilleries; on the continent of Europe the beet growers use farmyard manure, phosphates, ammonia, and rape cake, either to the root itself or to the preceding crop. The spent wash from distilling beet molasses is usually evaporated to make potass, but where the position of the distilleries admits of it the lees are frequently returned with advantage to the soil.* On Demerara plantations, where transport is altogether by water, and the tillage as yet by manual labour, so few stock are kept, the manure made from them would be of little account, and the lees are discharged into the draining trenches and led away to the sea.

On an estate belonging to my father in this colony, arrangements have been made to utilise the lees, by laying down pipes to carry them over the cane fields, where we hope to find them valuable as manure, and to be able in this way to abolish the great nuisance arising from the lees becoming putrid in dry weather, when there is little water in the trenches. It is proposed to accomplish this by pumping the spent wash into a tank elevated high enough—20ft. I think will do—to distribute it in iron pipes over the fields in cultivation. A main of 6in. in connection with the tank, will be laid up one of the side lines, with branch cocks at intervals of 173yds. for letting the liquid pass into, and be distributed over the fields on either side by means of portable 2in. pipes. These portable pipes are bored at the ends, each fitting into the other as a glass stopper into a bottle. They may be laid continuously for a mile, and are quite easily connected and disconnected. At their extreme end will be a few yards of gutta percha pipe, or perforated iron pipes on wheels, with leather joints, such as are used for watering the streets in Paris, and by means of which a man will

* "In the vicinity of Magdeburg the residue left after the distillation of beetroot molasses, which contains the soluble salts of the beetroot (no salts of ammonia), has, of late, been used as a manure; and I have been assured that fields treated with it have yielded, several years in succession, most abundant crops of rape, beet, &c."—Liebig on Modern Agriculture, p. 209.

direct the application of the liquid. Practical experience must decide the proper strength; applied fresh, the lees will probably be apt to burn, and may require to be reduced with water; it will possess still more beneficial effects where time can be given for fermentation previous to its being used.

The 6in. pipes are made in 9ft. lengths, and cost 3s. per yard. The 2in. pipes are made in 6ft. lengths, and cost 1s. 1½d. per yard. The cocks cost £2 12s. each. The pumps are to be attached to an existing distillery engine, and the plant, when laid down, will be equally applicable for distributing, in a liquid state, guano, or sulphate of ammonia, or for water irrigation, so valuable to the cane.

In Scotland, such a system has long been in operation on the large dairy farm belonging to the late Mr. Harvey, near Glasgow, where men may be seen daily distributing distillery wash from Indian corn, barley, or molasses. Its good effects are still more marked in the neighbourhood of Campbelton, where the wash from these well-known distilleries has for some years past been pumped over a farm of poor land, by which its value has been very greatly increased. In applying the lees from our plantation distilleries, we shall be returning to the land more of the salts which were taken from it in the cane. Sugar itself comes mainly from the atmosphere; on estates, therefore, where the whole of the molasses is distilled, if we are careful to restore all the Megass ashes, and all the lees, we shall be giving back to the land nearly everything that is required for building up the structure of the cane.

More attention is being paid of late years in the British West Indies, especially on vacuum pan estates, to the defecation of cane juice and its manufacture into sugar. It is a subject, the importance of which cannot be over-estimated; but depend upon it there is truth in the saying of the old planters, which we should not lose sight of, that "good sugar is made in the field." If attention is given to select good tops for planting, to apply the right sort of manures, to strip the canes judiciously, above all to cut at the proper time and grind without delay, wherever the seasons have been at all favourable, not only will there be heavy crops, but the work in the buildings will be materially simplified and economised.

COMMERCIAL & OTHER STATISTICS OF THE UNITED KINGDOM.

From Francis Reid & Co.'s Monthly Circular, January, 1870.

Year	ESTIMATED POPULATION, 31st Dec.	SUGAR, Raw & Refined		MOLASSES		TEA		COFFEE		COCOA	
		Tons	Lbs. per Head	Tons	Lbs. per Head	Lbs.	Per Head	Lbs.	Per Head	Lbs.	Per Head
1843	27,283,000	201,416	16·54	..	..	40,293,393	1·47	29,979,404	1·10	2,547,934	0·09
1844	27,577,000	206,472	16·77	..	..	41,363,770	1·50	31,352,382	1·14	2,589,977	0·09
1845	27,875,000	242,834	19·51	..	..	44,193,433	1·59	34,293,190	1·23	2,579,497	0·09
1846	28,189,000	261,933	20·81	..	..	46,740,344	1·65	36,754,554	1·30	2,951,206	0·10
1847	28,093,000	290,282	23·14	..	..	46,314,821	1·65	37,441,373	1·33	3,079,198	0·11
1848	27,855,000	309,424	24·88	..	..	48,734,789	1·75	37,077,546	1·37	2,919,591	0·10
1849	27,632,000	299,041	24·24	31,853	2·58	50,021,576	1·81	34,399,374	1·24	3,206,746	0·12
1850	27,423,000	310,391	25·35	40,653	3·32	51,172,302	1·87	31,166,358	1·14	3,080,641	0·11
1851	27,529,000	328,581	26·74	45,915	3·73	53,949,059	1·96	32,504,545	1·18	2,978,344	0·11
1852	27,570,000	358,643	29·14	38,662	3·14	54,713,034	1·98	34,978,432	1·27	3,328,527	0·12
1853	27,663,000	374,379	30.32	39,997	3·24	58,834,087	2·13	36,983,122	1·34	3,997,198	0·14
1854	27,788,000	416,620	33·58	42,336	3·41	61,953,041	2·23	37,350,924	1·34	4,452,529	0·16
1855	27,899,000	384,267	30·86	46,126	3·45	63,429,286	2·27	35,764,564	1·28	4,383,023	0·16
1856	28,154,000	374,978	29·69	47,111	3·75	63,272,212	2·25	34,995,944	1·24	3,634,135	0·13
1857	28,359,000	382,294	30·20	30,556	2·41	69,130,482	2·44	34,367,484	1·21	2,656,233	0·09
1858	28,566,000	450,203	35·30	43,829	3·44	73,217,484	2·57	35,338,111	1·24	3,071,115	0·11
1859	28,774,000	457,449	35·61	34,890	2·72	76,362,008	2·65	34,492,947	1·20	3,480,987	0·12
1860	28,944,000	448,070	34·61	27,998	2·58	76,859,428	2·66	35,674,381	1·23	3,481,484	0·12
1861	29,196,000	478,040	36·06	54,500	4·18	77,949,465	2·67	35,375,675	1·21	3,576,384	0·12
1862	29,400,000	485,856	37·24	55,840	4·22	78,817,060	2·68	34,664,155	1·18	3,926,500	0·13
1863	29,600,000	495,050	37·46	37,452	2·83	85,206,776	2·88	32,986,116	1·14	4,106,468	0·14
1864	29,820,000	499,604	37·53	25,341	1·90	38,637,099	2·98	31,591,122	1·06	4,171,082	0·14
1865	30,000,000	545,781	40·75	28,692	2·14	97,921,944	3·26	30,748,349	1·02	4,286,635	0·14
1866	30,050,000	559,160	41·68	32,285	2·41	102,325,067	3·41	30,944,363	1·03	4,606,997	0·15
1867	30,100,000	593,358	44·15	20,186	1·58	111,057,705	3·69	31,567,760	1·05	4,585,517	0·15
1868	30,200,000	561,135	41·62	37,379	2·77	106,918,118	3·54	30,608,464	1·01	5,730,223	0·19
1869	30,350,000	581,479	42·92	37,508	2·77	111,807,606	3·68	29,020,570	0·96	6,573,530	0·22

COMMERCIAL AND OTHER STATISTICS OF THE UNITED KINGDOM.

Year	RICE		TOBACCO		TALLOW		WINE		BRITISH & FOREIGN SPIRITS.	
	Tons.	Lbs. per Head	Lbs.	Per Head	Tons	Lbs. per Head	Gallons	Per Head	Gallons	Per Head
1843	12,760	1·01	23,012,627	0·84	58,747	4·82	6,068,987	0·22	22,020,307	0·87
1844	16,145	1·31	24,595,791	0·89	54,052	4·39	6,838,684	0·25	23,845,054	0·83
1845	13,466	1·08	26,162,159	0.94	59,595	4·79	6,736,131	0 24	26,665,501	0·91
1846	21,691	1·72	26,859,788	0·95	59,192	4·70	6,740,316	0·24	28,344,746	1·01
1847	55,166	4·40	26,638,136	0·95	53,465	4·26	6,053,847	0·22	25,534,820	0·91
1848	19,519	1·57	27,194,368	0·98	70,336	5·66	6,136,547	0.22	26,822,175	0·96
1849	25,474	2·06	27,553,238	1·00	70,624	5·72	6,251,862	0·23	28,216,149	1·02
1850	20,051	1·63	27,584,406	1·01	60,231	4·92	6,437,222	0·23	28,653,695	1·04
1851	19,173	1·56	27,915,024	1·01	54,049	4·40	6,279,759	0·23	28,742,691	1·04
1852	27,601	2·24	28,418,568	1·03	58,616	4·76	6,346,061	0·23	30,051,189	1·09
1853	38,917	3·15	29,564,605	1·07	66,848	5 41	6,813,830	0·24	30,151,075	1·09
1854	41,748	3·36	30,391,841	1·09	38,001	3·06	6,776,086	0·24	30,998,057	1·12
1855	48,345	3·88	30,332,657	1·09	39,714	3·19	6,296,439	0·23	26,731,609	0·92
1856	71,032	5·65	32,413,000	1·15	50,366	4·07	7,004,953	0·25	28,284,989	1·00
1857	74,523	5·85	32,680,369	1·15	53,586	4·20	6,605,710	0·23	28,864,186	1·02
1858	88,093	6·91	34,110,851	1·19	61,259	4·80	6,697,224	0·23	27,774,347	0·97
1859	65,334	5·09	34,791,261	1·21	51,825	4.03	7,262,965	0·25	28,790,364	1·00
1860	76,778	5.94	35,412,845	1·22	71,049	5·50	7,358,189	0·25	27,066,125	0·94
1861	79,172	6.07	34,976,453	1.20	57,596	4·42	10,787,091	0·37	25,097,640	0.86
1862	132,357	10·08	35,614,985	1·21	48,519	3·70	9,803,046	0·33	24,720,614	0·84
1863	73,225	5·54	37,616,246	1·27	56,333	4·26	10,478,057	0·35	24,718,991	0·84
1864	80,518	6·05	38,239,521	1·28	49,300	3·70	11,456,715	0·38	26,544,650	0 89
1865	27,264	2·04	39,179,801	1·36	66,015	4·93	12,061,386	0·40	26,990,464	0·90
1866	48,726	3·63	40,995,161	1·36	64,518	4·81	13,327,916	0·44	29,769,868	0·99
1867	78,868	5·87	41,053,612	1·36	52,076	3·84	13,754,343	0·46	29,090,697	0·97
1868	134,729	10·00	41,280,001	1·36	57,163	4·24	15,151,741	0·50	28,610,658	0·94
1869	186,884	13·79	41,648,157	1·37	64,126	4·73	15,019,690	0·49	..	..

COMMERCIAL AND OTHER STATISTICS OF THE UNITED KINGDOM.

Year	FOREIGN WOOL		COTTON		RAW SILK		TOTAL VALUE OF IMPORTATIONS	
	Lbs.	Per Head	Lbs.	Per Head	Lbs.	Per Head	£	Per Head
1843	46,281,811	1·70	633,573,166	23·22	3,310,246	0·12	Value not ascertained prior to 1854.	
1844	63,741,087	2·31	598,888,744	21·71	3,922,341	0·14		
1845	74,151,502	2·66	679,063,569	24·36	4,058,737	0·15		
1846	62,243,482	2·31	401,925,570	14·23	4,190,054	0,15		
1847	57,782,873	2·23	399,753,295	14·23	3·697,187	0·13		
1848	64,289,263	2·54	639,000,369	22·94	4,181,027	0·15		
1849	64,318,150	2·33	656,575,476	23·76	4,518,132	0·16		
1850	59,938,104	2·19	561,107,165	20·46	4,385,097	0·10		
1851	69,581,988	2·53	645,399,389	23·44	4,059,449	0·15		
1852	82,444,525	2·99	817,898,144	29·67	5,129,231	0·19		
1853	107,671,080	3·89	746,709,069	27·00	6,046,852	0·22		
1854	81,612,732	2·94	764,007,037	27·49	6,439,104	0·23	152,389,053	109/8
1855	69·846,980	2·50	767,383,792	27 51	4,433,307	0.16	143,542,850	102/1
1856	89,531,599	3·18	877,225,440	31·10	5,945,074	0·21	172,544,154	122/7
1857	93,262,679	3·29	837,391,296	29·53	10,371,306	0·37	187,646,335	132/11
1858	100,037,181	3·50	884,734,576	30·97	3,963,057	0·14	164,583,832	115/3
1859	104,267,884	3,62	1,050,845,836	36·52	7,768,564	0·27	179,182,355	124/7
1860	117,633,210	4·06	1,140,510,112	39·40	6,024,654	0·21	171,789,166	118/8
1861	92,795,737	3·18	958,696,816	32·84	4,613,689	0·16	179,034,444	122/8
1862	123,840,673	4·21	309,258,656	10,52	5,089,407	0,17	184,129,120	125/3
1863	113,449,703	3·83	428,230,768	14·47	5,368,226	0·18	203·826·363	137/9
1864	150,539,306	5·05	648,602,416	21·75	1,733,271	0·6	226,057,691	152/0
1865	129,761,317	4·33	675,069,360	22·75	4,586,260	0·15	219,393,987	146·6
1866	172·785,201	5·75	988,177,561	32·88	3,488,711	0.12	238,773,192	158/10
1867	142,951,240	4·75	911,910,496	30·21	3,947,634	0·13	220,862,585	146/9
1868	147,673,844	4·80	1,005,463,536	33·29	4,105,882	0·13	249,616,302	165/4
1869	157,182,320	5·18	939,237,376	30·95	2,617,628	0·09	247,656,072	163/2

COMMERCIAL AND OTHER STATISTICS OF THE UNITED KINGDOM.

Year	Total Value of British and Irish Produce Exported		Ships in Foreign Trade Entered Inwards		Railways in United Kingdom.		
	£	Per Head	Tonnage	Per Head	Capital Expended	Per Head	Nett Profit ℔ cent.
1843	52,206,447	38/3	4,847,296	0·18	60,637,100	44/5	4·94
1844	58,534,705	42/6	5,049,601	0·18	66,882,100	48/6	5·22
1845	60,111,082	41/8	6,045,718	0·22	75,616,100	54/3	5·48
1846	57,786,876	41/0	6,101,015	0·22	87,765,100	62/3	5·25
1847	58,842,377	41/11	7,196,033	0·26	114,728,000	81/0	4·09
1848	52,849,445	37/11	6,525,945	0·23	154,200,000	110/9	4·06
1849	63,596,025	46/4	6,912,900	0·25	197,000,000	142/7	3·44
1850	71,367,885	52/1	7,100,476	0·26	230,522,730	168/3	3·31
1851	74,448,722	54/1	7,872,094	0·28	236,841,420	172/1	3·67
1852	78,076,854	56/8	7,887,447	0·29	248,083,520	179/11	3·44
1853	98,933,781	71/6	8,943,107	0·32	263,636,320	190/7	3·80
1854	97,184,726	69/11	9,160,366	0·33	273,860,000	197/1	3·93
1855	95,688,085	68/7	8,951,239	0·32	293,903,000	210/8	3·90
1856	115,826,948	82/3	10,553,134	0·38	302,946,260	215/3	4·00
1857	122,155,237	86/2	11,475,199	0·40	311,153,670	219/5	4·19
1858	116,608,756	81/8	10,961,700	0·38	319,950,000	224/0	3·91
1859	130,411,529	90/4	11,221,922	0·39	328,219,100	228/2	4·13
1860	135,891,227	93/11	12,172,785	0·42	338,827,200	233/5	4·39
1861	125,102,814	85/8	13,179,589	0·45	352,386,100	241/4	4·30
1862	124,137,812	84/5	13,091,000	0·44	370,107,280	251/9	4·22
1863	146,602,342	99/1	13,256,063	0·45	387,246,200	270/8	4·25
1864	160,436,302	107/7	13,515,011	0·45	408,396,680	273/11	4·49
1865	165,862,402	115/1	14,317,886	0·48	433,558,100	289/0	4·46
1866	188,827,785	125/8	15,612,170	0.52	463,746,800	318/8	4·29
1867	181,183,971	120/5	14,827,617	0·49	479,167,300	318/4	4·18
1868	179,463,644	119/0	13,851,317	0·46	486,893,400	323/8	4·13
1869	189,089,242	124/7	14,403,128	0·47	490,950,770	323/2	4·45

COMMERCIAL AND OTHER STATISTICS OF THE UNITED KINGDOM.

Year	Declared Value of Gold, Silver, and Specie.				Bank Interest	Income Tax	
	Imported	Per Head	Exported	Per Head	An. av'age per cent.	Nett Amount Charged for Property and Profits	Per Head
	£		£				
1843	Not registered prior to 1868.		5,373,047	3/11	..		
1844			3,679,381	2/8	..		
1845			4,066,886	2/11	2·68		
1846			2,937,266	2/1	3·33		
1847			8,602,597	6/1	5·15		
1848			8,596,990	6/2	3·69		
1849			8,912,467	6/5	2·95		
1850			6,940,346	5/1	2·51		
1851			9,059,551	6/7	2·99		
1852			10,295,464	7/6	2·24		
1853			18,906,755	13/8	3·43		
1854			22,586,568	16/3	5·11		
1855			18,828,178	13/6	4·78		
1856			24,851,797	17/8	5·83	265,338,109	190/7
1857			33,566,968	23/8	6·66	274,114,003	193/4
1858	29,493,190	20/8	19,628,876	13/9	3·03	292,694,508	204/11
1859	37,070,156	25/9	35,688,803	24/10	2·74	293,666,988	204/1
1860	22,978,196	15/11	25,534,768	17/8	4·18	299,232,878	206/9
1861	18,747,045	12/10	20,811,648	14/3	5·21	301,345,865	206/5
1862	31,656,476	21/6	29,326,191	19/11	2·53	317,070,986	215/8
1863	30,030,794	20/3	26,544,040	17/11	4·40	323,949,129	218/11
1864	27,728,276	18/7	23,157,515	15/6	7·35	326,696,050	219/1
1865	21,462,211	14/4	15,210,994	10/2	4·75	349,301,654	232/10
1866	34,287,139	22/9	21,970,687	14/5	6·90	364,430,553	248/6
1867	23,821,047	15/10	14,327,289	9/6	2·54	374,342,902	248/9
1868	24,852,595	16/6	20,220,014	13/5	2·10	Not yet Published	..
1869	14,317,855	9/5	9,623,638	6/4	3·20		..

THE SUGAR CANE IN THE BRISBANE BOTANIC GARDENS.

(*From the Queenslander.*)

As the results of the experience of every sugar grower are, to some extent, important in the present stage of this industry in Queensland, I need make no apology for furnishing you with the following remarks and figures. There is, at present, in the Botanic Gardens of Queensland, about one-eighth part of an acre of ground under sugar cane, as no doubt most of the visitors to the gardens have observed. This miniature experimental plantation was formed about two years ago, and it contains seventeen varieties of cane, being as varied a collection as is to be found at present in this or the neighbouring colony of New South Wales. At the end of the first year I caused the crop of canes to be cut down for distribution, and they were sent to many different parts. In this—the second year of growth—I have recently caused a number of each variety of cane to be cut down for the purpose of having them manufactured into sugar, so that I might ascertain by comparison the relative sugar bearing qualities of each variety, thinking such comparison would be useful and interesting to the growers of the cane and the manufacturers, and that the results would therefore be worthy of publication. For being enabled to effect this object, I am indebted to the kindness of the pioneer grower and manufacturer of sugar in Queensland, the Hon. Louis Hope, to whose enterprise the colony is so deeply indebted for the inauguration and development of this valuable industry. This gentlemen, at much trouble and expense to himself, undertook the manufacture of a small parcel of each variety of cane, and supplied me with the different quantities of sugar produced and the subjoined results in figures. The samples are, at present, on view at the office of *The Queenslander* in George Street. The following in the return forwarded to me by the Hon. Louis Hope:—

PARTICULARS OF SIXTEEN SAMPLES OF CANES FROM BRISBANE BOTANIC GARDENS, MANUFACTURED AT ORMISTON PLANTATION.

No.	From.	Names of Canes.	Weight of Cane.	Density of Juice	Return in Sugar.		Return in Sugar per ton of Cane.	
			Lbs.	Degs.	Lbs.	Ozs.	Lbs.	Ozs.
1	Java	Socrat	50	10	1	8	67	3
2	,,	Rappoe Var	32	10	0	15	65	10
3	,,	Rappoe	50	10	1	9	70	3
4	,,	Meera	53	11	1	6	58	0
5	,,	Poctii	38	10	1	5	77	6
6	,,	Djœngdjœng	51	10	1	10	74	6
7	,,	Lielium	52	11	0	10*		
8	New Caledonia	Chigaca	24	10	1	8	140	0
9	,,	Troeboe	54	10	1	3	49	4
10	Mauritius	Belouguet	52	10	1	4	53	13½
11	,,	Salangore	54	9	0	15†		
12	,,	Diard	49	11	1	15	88	9
13	Near Brisbane	Bourbon	49	9	0	9‡		
14	,,	Chinese, or Otaheite	37	9	0	6§	22	11¼
15	New Caledonia	Red Ribbon	20	9	0	13½	103	4
16	,,	Green or yellow.	19	9	0	14	94	8

In order to place the result in a clear and practical shape, I have myself from the actual figures obtained worked out the calculation (in the last column) as to the return in sugar of each ton. The returns are in round numbers within a fraction of an ounce, and are, I believe, accurate; but any one of your readers so inclined can test the accuracy by working out the calculation from the given figures..

* Leakage from Cooler.

† Juice lost: leakage from cooler.

‡ Cooler leakage: juice lost.

§ Much molasses.

Those who have visited the gardens, and noticed the ground in which the canes are planted, will have observed that it is not so well situated as could be desired, as the proximity of the bamboo trees interferes with the due amount of sunshine that the canes should receive. It is well known to sugar growers that it is an essential point to choose ground which may possess an aspect and obtain the influence of the sun to the greatest extent possible. The ground referred to also labours under a defect of underdraining, which, owing to its situation, could not be well rectified. Considering, therefore, these drawbacks, the results may be deemed highly satisfactory. The canes were planted in trenches five feet apart and fifteen inches deep. In these the cuttings were placed fifteen inches apart.

It may be advisable to briefly state the circumstances under which the above nomenclature and classification, for which I am not responsible, is adopted. In the year 1866 I wrote to Java, and received the canes from that island, with the different names, as above, attached to each variety. Therefore, when it appears that, as above, a certain variety of cane came to me from Java, it does not follow that the cane is a native of that island. The above names of countries simply indicate the places from which I procured the cane. I am not in a position to state at present authoritatively the parent soil, so to speak, of each variety of cane. The four localities mentioned are only the channels through which I received the canes. A more close classification than at present obtains in this or the neighbouring colony, framed on a well defined basis as regards the different peculiarities of each variety, will no doubt be made at some future time, and it would certainly be desirable that some common classification of a more definite character than exists at present should be, as soon as possible, adopted by us.

In connection with the above figures, it may be as well to state, for the information of some readers, that the yield of cane to the acre, of course, varies, but that forty tons to the acre may be put down as the lowest yield, whilst from fifty to sixty tons are frequently obtained.

Appended to the report furnished to me by the Hon. L. Hope,

are the following remarks, which show that the return is, owing to unavoidable causes, somewhat imperfect; "the juice of several of the varieties leaked from the coolers, so that the quantities vary. No. 8 gave much juice, and yielded well. No. 14 is poor in every respect but hardiness." In conclusion, the samples of sugar appear to me to be of admirable qualities, and have been pronounced to be so by those competent to judge to whom I have shown them; but on this question of quality each person may judge for himself by a personal inspection of the samples at the office where, as above mentioned, they are on view.

Yours, &c.,
WALTER HILL.

Botanic Gardens, Brisbane, October 26.

Correspondence.

THE SUGAR DUTIES.

MINCING LANE, 22ND JANUARY, 1870.

SIR,

Sugar was the article on which Sir Robert Peel, more than a quarter of a century ago first successfully experimented, and increased the revenue by reducing the duty £10 per ton. The admission of slave grown sugar is the only great alteration which has since taken place, and on low descriptions the tax amounts to over 50 per cent. upon cost price. To again cheapen sugar by a material reduction of duty would confer a great boon on the country, by adding to the food of the people, and then molasses and even sugar might be used beneficially in feeding stock of all kinds.

The opinion seems generally to prevail, that the time has arrived when the attention of the Chancellor of the Exchequer must be turned in this direction, for there is no other taxed article the proper treatment of which would benefit the British nation nearly in the same degree.

The present mode of taxing sugar is supposed to be a difficult matter to understand, it is really very simple. A supply of sugar may be obtained from tropical countries in almost any quantity, if we do not reject that made in the rudest manner; whilst we take from France, Holland, and Belgium sugar of the highest class at so low a price that the British refiner believes there must be a secret bounty on its exportation in violation of the convention.

The following Table explains how the Scale of Duties acts, as regards per centage on cost:—

	Cost per ton at place of manufacture.				
Duty, £8 per ton....	£10	Taxed at	80	per cent.	on cost.
	£11	,,	72¾	,,	,,
	£12	,,	66½	,,	,,
	£13	,,	61½	,,	,,
	£14	,,	57	,,	,,
	£15	,,	53¼	,,	,,
Duty, £9/11/8 per ton	£16	Taxed at	60	per cent.	on cost.
	£17	,,	56¼	,,	,,
	£18	,,	53¼	,,	,,
	£19	,,	50½	,,	,,
Duty, £10/10 per ton	£20	Taxed at	52½	per cent.	on cost.
	£21	,,	50	,,	,,
	£22	,,	47¾	,,	,,
	£23	,,	45½	,,	,,
Duty, £11/5 per ton .	£24	Taxed at	46¾	per cent.	on cost.
	£25	,,	45	,,	,,
	£26	,,	43¼	,,	,,
	£27	,,	41½	,,	,,
Duty, £12 per ton ..	£28	,,	43¾	per cent.	on cost.
	£29	,,	41½	,,	,,
	£30	,,	40	,,	,,
	£31	,,	38¾	,,	,,
	£32	,,	37½	,,	,,
	£33	,,	36¼	,,	,,
	£34	,,	35	,,	,,

From the above statement it is clear that under no other system of taxation could the lowest kinds of raw sugar be imported, therefore a scale of duties is good for the consumer, the merchant, the refiner, and the revenue, and when a reduction is made the scale should be maintained for the sake of "encouraging the largest possible supplies of sugar from the various sources of production, in whatever form the same may be imported, whether as refined sugar, or in combination with other substances to be afterwards separated by the process of refining."

The following has lately appeared in the *Gazette:*

DRAWBACKS ON SUGAR.

The following declaration regulating certain points connected with the execution of the Convention concluded at Paris, November 8th, 1864, relative to drawbacks on sugar, was signed at Paris, on the 27th December last:—

The Governments of Great Britain, Belgium, France, and the Netherlands being desirous to regulate, by common agreement, certain questions connected with the execution of the Convention of the 8th of November, 1864, relating to the sugar system, the undersigned, duly authorised to that effect, and after having taken cognizance of the final Protocol signed on the 5th of October of the present year by the Commissioners of the four Governments assembled in conference at the Hague, have agreed upon the following arrangements:—

Article 1.—The period granted to the French Government by the Declaration of the 4th November, 1868, for establishing an exact correlation between the duties to be levied on raw sugars, and the yields fixed by the declaration of the 20th November, 1866, is extended to the 30th of June, 1871.

Article 2.—Provisionally, the duty on the importation into France of refined sugars coming from the other contracting States remains fixed at forty-eight francs eighty-five centimes (48f. 85c.).

Article 3.—The limit of exportation of pieces produced from sugars admitted under the system of temporary importation, which was fixed by the second paragraph of Article 10 of the Convention

of the 8th November, 1864, is lowered from standard No. 10 to standard No. 7.

Article 4.—Each of the contracting governments shall be at liberty to sub-divide the classes of raw sugar mentioned in Article 1 of the Convention of the 8th of November, 1864, and to create sub-standards corresponding to such subdivisions, without however, having the power to modify the limit of any one of the actual classes, nor to lower the average yield of the different qualities of sugar comprised in those classes.

Article 5.—The present arrangement shall come into execution from and after the 1st of January, 1870.

In witness whereof the undersigned have drawn up the present declaration, and have affixed to it the seal of their arms.

Done at Paris, the 27th of December, 1869.

(L.S.) LYONS.
(L.S.) Bn. EUG. BEYENS.
(L.S.) Pce. DE LA TOUR D'AUVERGNE.
(L.S.) Bn. DE ZUYLEN DE NYEVELT.

How, may I ask, can the duty be reduced, if we have not "the power to modify the limit of any one of the actual classes, nor to lower the average yield of the different qualities of sugar comprised in those classes?"

The present scale reduced one-half would leave five rates, £6, £5 12s. 6d., £5 5s., £4 15s. 10d., and £4. Whilst the above declaration debars us from charging £1 per ton upon loaf, and 10s. per ton upon all other kinds of sugar. How absurd it would be to charge 1st class £1, 2nd class 18s. 9d., 3rd class 17s. 6d., 4th class 15s. 11¾d., 5th class 13s. 4d.

The Sugar Convention has done no good, I trust it is doing no harm, but the best way out of the difficulty is to abolish our Sugar Duties altogether.

Your obedient servant,
A MERCHANT.

We quite agree with our correspondent that the obtaining of the largest supply of sugar of whatever quality is the most important

consideration in the question of the sugar duties; and there is no doubt but that their entire abolition would most effectually conduce to this end. It is equally unquestionable that a fixed duty would in proportion to its amount tend to discourage the import of low sugars, and either greatly diminish their production, or cause them to be shipped to Belgium or France, where the drawback is in favour of the refiner; whence they would be re-shipped to this country in the form of loaves or crushed, thus enhancing the price to the consumer, and leaving a large profit in the hands of the foreign refiner.

With perfect freedom of trade, it would be shown that it is rarely the interest of the sugar planter to become a refiner, even to a limited extent. When we consider the scarcity of labour, and especially of skilled labour in our sugar growing colonies, the great cost of machinery of a character very liable to derangement, the high rate of interest on capital, the high price of fuel, and sometimes the scarcity of water; and further, take into account that the cane crushing lasts only at most one third of the year, during the rest of which the costly machinery and the skilled labour would to a great extent be idle, it must be obvious that except under special circumstances it is the interest of the grower to send his produce to market as nearly as possible in the state of raw material, as is consistent with finding for it a ready sale.

The graduated scale is imperfect, inasmnch as several numbers are included in one class, but the statement that the duty is assessed entirely by colour is incorrect, for both grain and freedom from moisture are also taken into account in classing the samples.

Sugar has higher claims than any other article in the customs to be considered in the appropriation of surplus revenue; it is not merely an adjunct to the breakfast table, but an important and necessary article of food; its free import would not only be felt in every home in the kingdom, but would materially promote the prosperity of many colonies towards which the mother country has duties which should not be lost sight of even in our home legislation, —ED. *S. C.*

NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

BY WILLIAM ARNOT, F.C.S.

(From the Chemical News.)

PREJUDICIAL ACTION OF SULPHITES AND SULPHATES IN THE REFINING PROCESS.

BESIDES the impurities natural to unrefined cane sugars, and which vary in quantity, and to some extent in quality also, according to the care bestowed in the manufacture and other local circumstances, there are not unfrequently present one or more injurious agents which have been introduced, not as adulterants, but to counteract some adverse natural circumstance or action. Among these agents bisulphite of calcium occupies a prominent position. In several cane-growing countries the natives, or colonists, are dependent in great measure upon wind power for the performance of certain mechanical operations; pressing the juice from the cane is one of these. The canes being ripe and the wind fair, the planter proceeds to cut down his crop; but, before this is well accomplished, the wind falls; what is to be done? To allow the cut canes to lie in their natural condition until a favourable breeze springs up, may be to submit to a very serious loss of crystallizable sugar by fermentation. To counteract this destructive process, bisulphite of calcium, mixed with water to the consistency of ordinary milk of lime, is sprinkled over the canes from time to time, until the elements supply the necessary motive power to allow the pressing to proceed. As the pressing goes on, the lime salt mingles with the juice, and is never afterwards entirely removed from the manufactured sugar. Much of the raw sugar which arrives in this country, to undergo the process of refining, thus contains notable quantities of sulphites and sulphates; these range in quantity from the merest trace to amounts which might seem to some incredible. In these circumstances it becomes important to ascertain the action of these salts in the refining process, and their consequent effect upon the value of sugars containing them. In the first place, they, of course, in common with all other impurities,

reduce the percentage quality of saccharine matter in the sample; and as it often enough occurs that the *best looking* samples contain the impurities referred to in greatest quantity, it is always advisable to estimate the total impurities previous to purchase. The sugars being blown up and mechanically filtered, are next submitted to the purifying and decolorising action of animal charcoal; in this process a large proportion of the sulphites and sulphates are removed and retained within the pores of the char. The washing, to which the char is afterwards subjected, removes a portion of these salts along with other impurities, but they are never entirely washed out. The re-burning succeeds the washing, and in this process the sulphates, or a portion of them, depending upon the temperature at which the re-burning is conducted and other minor circumstances, are decomposed at the expense of the carbon—carbonic anhydride being evolved and calcium sulphide formed. The char being re-burned and cooled is ready for its work of decoloration again; the sugar liquors—acid almost to a certainty—are run upon it, and as they pass through, decompose the calcium sulphide, with formation of hydric sulphide, which the liquors absorb. There are thus two prejudicial effects produced: first, the removal of a portion of the most valuable agent in the char—the carbon—and next the formation of an agent in the sugar solution, which is most potent in promoting fermentation, and consequent destruction of saccharine matter. The quantity of carbon removed and hydric sulphide produced by one complete circle of the refining process is comparatively trifling, but when it is remembered that the same char is often re-burned and used twice a week, the ultimate extent of the injury can be imagined. From extended personal observation, the author of these notes is satisfied that from 10 to 20 per cent of the decolorative power of animal charcoal may be destroyed in the course of twelve months by a continued use of sugars containing the agents referred to.

A little consideration will show, what numerous experiments have proved, that char *ready for re-burning* seldom or never contains sulphides, while re-burned char always contains more or less; *traces* of sulphur compounds being, as a rule, present in all unrefined sugars.

WEST INDIAN TAXATION AND PRODUCTION.

	Area Square Miles.	Population per last Published Statement.	Number of Children at School.	Proportion to Population.	Exports in 1866.	Taxation in 1866.
					£	£
Virgin Islands	57	6,051	473	1 in 13	8,313	1,995
Antigua	183	36,412	3,505	1 in 10	291,860	45,182
Montserrat (about) ..	47	8,348	871	1 in 9½	19,898	5,325
Nevis	50	11,000	687	1 in 16	46,549	6,999
St. Kitts	103	24,440	2,803	1 in 9	173,391	24,504
Dominica	291	25,065	858	1 in 29	106,452	19,166
		111,316			646,463	103,171
Barbadoes	166	152,727	11,438	1 in 13	1,246,844	103,935
St. Lucia............	250	29,519	1,829	1 in 16	109,482	15,294
St. Vincent..........	131	31,755	2,735	1 in 12	194,173	20,680
Grenada	133	35,672	1,418	1 in 25	113,237	21,464
Tobago	97	15,410	Not	returned.	69,872	9,814
		265,083			1,733,608	171,187
*Trinidad	1,754	84,438	3,146	1 in 27	1,022,338	226,218
British Guiana	76,000	148,026	6,615	1 in 22½	2,170,967	304,816

* A Crown colony, in which the inhabitants have never had any control over the Government.

THE YEAR 1866 IS TAKEN, BEING THE YEAR TO WHICH THE REPORTS PRESENTED LAST SESSION REFER, and also as being a season in which the production of sugar was fully up to the average, whilst that of the following year was very deficient in many of the islands.

In the Official Returns, the forms in which the accounts of the several colonies are given are very dissimilar, so that it is not unlikely that the sums entered above as Administrative Charges may in some cases comprise items omitted in other cases.

WEST INDIAN TAXATION AND PRODUCTION—(*Continued*).

	Taxation per Head.			Percentage of Taxation on Exports.	A. Salaries and Administrative Charges.	Percentage of these to whole Taxation.	Expenditure in 1866 on Immigration.	Expenditure in 1866 on Education.	B. Sanatory and Hospitals.
	£	s.	d.	Per Cent.	£	Per Cent.	£	£	£
Virgin Islands	0	6	7	24	845	42	....	64	
Antigua	1	4	10	15	5,842	13	361	975	3,742
Montserrat (about)	0	12	9	27	1,357	25½	,,	,,	None.
Nevis	0	12	8	15	2,301	33	,,	,,	110
St. Kitts	1	0	1	14	4,933	20	,,	927	2,055
Dominica	0	15	3	18	10,091	53	,,	798	532
Barbadoes	0	13	7	8	21,564	21	None.	3,917	2,676
St. Lucia	0	10	4	14	7,272	47½	,,	724	998
St. Vincent	0	13	0	11	6,827	33	654	865	1,028
Grenada	0	12	0	19	Not distinguish'd	in the Return.	,,	1,242	Not separated in the Return.
Tobago	0	12	9	14	3,710	38	,,	300	
Trinidad	2	13	7	22	75,446	33	37,750	751	14,663
British Guiana	2	1	2	14	62,315	20½	30,926	14,627	22,542

A. Includes Post Office Charges, but not Police, Ecclesiastical, Educational, Medical, or Hospital expenses.
B. Hospitals, Medical Relief, and General Sanatory charges.

In the above tables Jamaica is omitted, as, from the smallness of the exports compared with the population, the position of that island does not admit of a fair comparison with the other West Indian colonies. It will be observed that, as a rule, the colonies which in 1866 enjoyed representative institutions were the most economically governed, in proportion both to the population and the production. If, for instance, we compare Barbadoes and Trinidad, we shall find that although the former stood first both in population and production, and had three times as many children at school, yet the administration of the Government under representative institutions did not cost one-third of the sum expended in Trinidad by Crown nominees.

THE CONCRETOR IN AUSTRALIA.

In our last number, we spoke of Dr. Neild's Concretor as being the first introduced into Australia, we now find that it is probable we were mistaken, the following extract from a letter having been forwarded for our perusal:—*Ed. S. C.*

"I have just returned from a visit to our Sugar Mill on the Clarence River, where I had an opportunity of testing for the first time in the colony, the working of one of the largest sized Concretors. The simplicity of the process and the perfection of the mechanism employed could not possibly be exceeded, and the concrete produced appears admirably adapted for the work of our refineries. I sent, by last mail, an order for four additional Concretors of largest size."

NEW PATENTS.—FROM THE MECHANICS' MAGAZINE.

1866. J. H. Johnson, Lincoln's Inn-fields. *Manufacture of sugar.* (A communication.) Dated June 17, 1869.

The extraction of saccharine juice by the aid of chemical preserving or desiccating agents, such as sulphate of lime, chloride of calcium, or their chemical equivalents, whereby a ready and economical purification of the sugar thus extracted may be effected.—Patent completed.

1915. W. Spence, Quality-court. *Manufacture of sugar.* (A communication.) Dated June 23, 1869.

This relates to the extraction of the juices of beet-root applicable to the manufacture of sugar and to distilling purposes, and has for its object the saving of manual labour for grating, also the dispensing with hurdles, sacks of wollen and other fabrics, with costly maintenance and frequent injury to the juices; also the increasing of the yield of sugar or alcohol by the regular washing of such pulp as it passes from the grater, being, first, well pressed, then washed and pressed again, and afterwards allowed to fall into a waggon or other suitable receptacle, all in the course of about five minutes, more or less.—Patent completed.

1962. E. T. Hughes, Chancery-lane. *Sugar.* (A communication.) Dated June 29, 1869.

This consists in the application of hydraulic and atmospheric pressure to the processes of claying and clearing sugar. The pressure is applied at from

1-5th to three atmospheres, and the process (now occupying from three to five days) is completed in from half an hour to six hours' time, according to the height of pressure and the quality and quantity of sugar to be clayed and cleared.—Patent completed.

FOREIGN PATENT.—FROM THE "JOURNAL DES FABRICANTS."

86989. LAGRANGE & GUILLON. *Process of Clarification and Purification of Syrups and Saccharine Juices applicable to the Manufacture and Refining of Sugar.*

For a long time, say the inventors, the inconveniences resulting from the use of blood and animal charcoal in factories and refineries, and the imperfection of the results obtained from these agents, have attracted the attention of manufacturers and of chemists. The process conceived by M. M. Lagrange & Guillon aims at clarifying and decoloring the juices and syrups treated in manufactories and refineries. It supersedes the use of blood, of fine charcoal, and perhaps totally or partially of granular charcoal.

The process is based on the systematic employment of lime and sulphate of alumina, in proportion to the degree of purity and colour required in the product. The system does not involve the use of any special machinery, but renders useless some apparatus at present employed. In order to clarify syrups and saccharine juices, the inventors submit them in the first place to defecation, by a quantity of lime varying from 3 to 10 per cent. of the weight of the syrups, taken at 30° Baumé; the proportion depending on the nature of the syrups and the degree of purity and decoloration desired. As soon as the lime is dissolved, a solution of sulphate of alumina is thrown into the syrup, in proportion to the quantity of lime employed, taking care to leave the syrup slightly alkaline. It is then raised to the boiling point, when the sulphate of alumina precipitates all the lime, and two insoluble products are formed, viz., sulphate of lime and alumina. These substances are favourable to decoloration, and it is when the alumina is first liberated that the decoloration and purification of the syrup is chiefly effected; the foreign and colouring matters are united with the precipitate, which is then separated by filtration. The inventors state that the use of *pure* alumina in the juice and syrup produces effects not to be compared to those of the new process.

When the maximum amount of lime is used, the syrup may be sent at once to the vacuum pan without passing over granular charcoal. In fact, the syrup is immediately and completely decolorized. When syrups are treated with 1, 2, 3, or 4 per cent. of lime, with only sufficient quantity of the sulphate of alumina to produce the requisite alkalinity, the degree of decoloration is proportionate to the quantity of lime used; so that by the

systematic addition of lime and sulphate of alumina the desired colour, or even the complete elimination of colouring matter, may be obtained at a single operation, without the use of blood, of fine charcoal, or even of granular charcoal, being required,

The precipitate can be washed easily, and the washings used in the manufacture, and, what is very important, the colouring matters are not redissolved in the washings, which are of no darker colour than the syrups; besides which, it is thought that the washed precipitates may be submitted to a process by which the sulphate of alumina will be re-formed, so that this reagent can be used in successive operations.

The inventors give the following instance of the application of their system; when a syrup, gauging 30° Baumé, made from sugar of No. 12 quality, is treated with 3 per cent. of its weight of quick lime, with sufficient sulphate of alumina to precipitate it and leave the syrup slightly alkaline, a decoloration is obtained, after boiling and filtration, equal to that of a syrup from white sugar; if the quantity of lime is increased to 10 per cent., a decoloration is effected, producing a syrup equal to that obtained by filtering a concentrated syrup made from white sugar through revivified charcoal.

STOCKS OF RAW SUGAR IN THE CHIEF MARKETS OF THE WORLD, IN THOUSANDS OF TONS, TO NOVEMBER 30.

	1869.	1868.
United Kingdom	115	136
France	98	125
Holland	16	33
Zollverein	37	46
United States	88	50
Cuba	19	15
Total	373	402

CONSUMPTION IN EUROPE AND UNITED STATES, IN THOUSANDS OF TONS, FOR YEAR ENDING NOVEMBER 30.

	1868-9.	1867-8.
Europe	1283	1194
United States	425	420
	1708	1584

SUGAR STATISTICS—GREAT BRITAIN.

To 29th Jan., 1870. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	9	1	1	1	12	27	2	1	..	2	5	6	3	..	..	1	4	12
British East India	13	3	..	..	17	11	1	..	..	..	1	3	1	..	..	..	2	1
Mauritius	4	..	1	1	8	8	1	..	1	1	3	3	..	..	1	..	2	2
Cuba	10	3	..	6	19	19	..	1	1	2	4	5	..	2	1	2	5	6
Porto Rico, &c. ..	2	1	..	1	4	3	..	..	..	..	..	..	1	1	..	..	2	1
Manilla, &c.	37	6	..	1	43	47	2	..	..	..	3	3	1	1	..	1	4	2
Brazil	1	7	1	3	11	23	..	2	..	1	3	6	..	2	..	1	3	5
Beetroot, &c.	3	1	..	3	7	4	3	1	..	2	7	5	2	1	..	2	6	4
Total, 1870 ..	78	21	4	16	119	143	10	5	3	8	26	31	9	8	3	7	28	32
Total, 1869 ..	78	40	7	22	24decrease		14	4	6	7	5 decrease		13	7	2	10	4 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKETS.

The markets during the past month have been dull for nearly all descriptions of raw sugar, and lower sorts have submitted to a decline of above 1s. per cwt. Refiners and the trade generally have bought only to supply their immediate wants. In refined goods of the better class there is no change in value, but yellow pieces are difficult of sale at lower prices.

Stocks in the United Kingdom show about the same decrease, although the deliveries during the month have fallen off, owing to the little business which has been done. On the Continent the most striking feature of the recent statistics is the slight increase of the general stock, notwithstanding the unprecedented crop of beet-root sugar. The season for this being now far advanced, the probable yield can be estimated with the greater certainty; and the highest anticipations of the most sanguine have been more than realized, the increase over last season's crop being above 100,000 tons; the larger part, however, of this excess is in countries which export little or none of their saccharine produce, and the whole overplus scarcely more than covers the increased consumption of continental Europe during the past year.

Accounts from the various colonial sugar countries are generally favourable, and it is probable that their export will be slightly in excess of last season; but against this must be placed the increase in the consumption in the United States of America, which increase it is said averages 2 lbs. per head per annum of the entire population, or in the aggregate 35,000 tons, which will not be made up by increased production in Louisiana for some time to come.

Taking all these circumstances into account, with the fact that the present small stock in the United Kingdom is mainly of a very low description, and that there is only a few weeks' supply of the better class of goods, that the increased yield of beet-root sugar will be mainly required for Continental consumption, and that, although it is now on an average 2s. per cwt. lower than cane sugar, yet that very little enters into direct consumption in this country, we incline to the opinion that the depression is merely temporary; in fact, during the last four days, raw sugars are decidedly firmer.

THE

SUGAR CANE.

REGISTERED FOR TRANSMISSION ABROAD.

No. 8. MARCH 1, 1870. Vol. II.

☞ The writers alone are responsible for their statements.

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THE SUGAR INDUSTRY OF JAVA.

By J. S. Millard, Esq.

[From the Dutch.]

(*Continued from page* 86.)

In 1827, Crespil, the well known manufacturer, stated before the French Chamber of Deputies, that the [average] cost of production of beet sugars did not exceed 60 francs per 100 kilogrammes, (24s. per cwt.); in the department, *du Nord*, however, it reached considerably more.

Until lately, the cost of manufacture could not be fixed at much less than 60 francs, a sum which made many fear that the manufacture would not pay; and a diminution of those costs, by a better method of working and improved apparatus, by which an increased yield is obtained from the roots, has been the aim; as yet, however, the lowest cost is estimated at 50 francs. Should the yield of juice be materially increased, there will then be a prospect of sugar being obtained from the beet-root for 40 francs (16s. per cwt.)

To determine the cost of production exactly, the price of the refuse and the syrups, of which the value varies considerably, is subtracted. Commonly the yield of the pulp (as food for cattle) is estimated at 20 per cent. of that of the weight of beet-roots; frequently it fetches 8s. 4d. per ton, sometimes more.

The price of syrups depends principally on that of the alcohol, which is made from them. Last year, the low price of the latter made a difference of more than 2s. per cwt. on the costs of manufacture in France. Generally, 2 per cent. of the weight of beet-roots is reckoned for molasses. The price in France is, at present, from 5s. to 6s. per cwt.

The average cost of production, after subtracting the yield of pulp and syrups, may with some certainty be reckoned in France, at the least, at 50 francs per 100 kilogrammes (£1 per cwt.) for *bonne quatrième*, equal to No. 12 of the Dutch standard.

The experienced manufacturer and well known author, Louis Walkhoff, gives the following statistics of the cost of growing and manufacturing beet-root sugar, from a certain extent of land:—

	When the Beets are grown by the Manufacturer.		When the Beets are bought by the Manufacturer.
Germany,	£27 per acre,	averaging 29/6 per cwt.	.. 31/0 per cwt.
France ..	33 ,,	,, 30/6 ,,	.. 36/6 ,,
Russia ..	20 ,,	,, 30/9 ,,	.. 31/0 ,,

The above includes the excise duties, which in Germany are about 9s. 6d. per cwt.; France, 11s. per cwt.; and in Russia, 4s. 3d. per cwt. Deducting these, the cost of production alone will be as under:—

	When the Beets are grown by the Manufacturer.	When the Beets are purchased by the Manufacturer.
Germany	20/0 per cwt.	21/6 per cwt.
France......	19/6 ,, ...	25/6 ,,
Russia	26/6 ,, ...	26/9 ,,

In the Netherlands, the cost of manufacture with a yield of 6 per cent. from the beet-root is, from 18s. 6d. to 20s. 6d. per cwt. Take the latter, to this should be added at least 5 per cent. interest on capital, and 4 per cent. sinking fund, on a capital of, say £30,000, required for the production of 800 tons of sugar per annum, = 3s. 4d. per cwt., or a total cost of nearly 24s. per cwt.

But, as opinions on interest, sinking fund and dividends vary a good deal, and as in Java, the manufacturer is bound by a limited

term of contract, whilst in Europe there is no fixed term, it will be safest to leave these out of consideration, notwithstanding they really ought to be included in the costs of production; but for purposes of comparison it will be sufficient to take cost of manufacture and growth, and as regards Java freight to Europe, and then it will appear that the advantage is in favour of Java sugars, the total cost of which is about 20s. 6d. per cwt., besides which, being intrinsically better in quality than beet sugar, it is worth 2s. to 3s. per cwt. more, both to the refiner and to the trade.

It must also be observed that in most beet sugar producing countries this industry is protected to a greater or less extent, either by higher duties on colonial, or by the yield of sugar from the crop being taken by the excise at less than the reality. In Germany, this system of protecting a few producers at the general cost is exciting opposition, and history shows that protection, gradually it may be, will certainly be abrogated in time.

The average value of beet-root sugar, *bonne quatrième*, in Paris for 13 years, is shown by the following table:—

	Frs.			s.	d.	
1855	69·40	per 100 kilos.,	about	28	0	per cwt.
1856	74·07	,,	,,	30	0	,,
1857	88·52	,,	,,	36	0	,,
1858	65·69	,,	,,	26	6	,,
1859	69·57	,,	,,	28	0	,,
1860	70·76	,,	,,	28	6	,,
1861	68·49	,,	,,	27	9	,,
1862	61·19	,,	,,	25	0	,,
1863	74·03	,,	,,	30	0	,,
1864	61·20	,,	,,	25	0	,,
1865	60·31	,,	,,	24	9	,,
1866	55·68	,,	,,	22	6	,,
1867	56·50	,,	,,	23	0	,,
Average	67·50	,,	,,	27	6	,,

The estimate of Walkhoff, may therefore be accepted.

A comparison of the costs of production, with the selling prices

of sugar, leads to the conclusion that it is not the manufacturer so much as the cultivator of the beets who reaps the profit. To the former, who is often obliged to sell his sugar at the cost price of production, little more remains for interest on capital, improvements, &c. than the refuse of the manufacture, and his application of this often constitutes his whole gain. Besides this, it often happens that any apparent gain is only obtained in the first months of the season, and that it entirely vanishes in the latter part of it, when the beet-root mostly becomes poorer in crystallizable sugar, and contains more noxious and fermentable substances. For this reason, manufacturers of beet-sugar are recommended by all competent advisers, not only to lay hold of every improvement in process which shall increase the saccharine yield, but to endeavour as far as possible to raise the "number" of their sugars, and to deliver only the whitest they can make.

It is worthy of note, that whilst in Europe efforts are continually being made to reduce the costs of production, in Java, all the measures of the government seem to have an opposite tendency; this might perhaps be less objectionable if it was not artificially produced, and if it followed the course of the markets of the world. Notwithstanding this, Java is no respect behind any sugar producing country, and it would be slighting the gifts of nature to neglect there the advancement of the cane sugar cultivation, of which Dr. Wagner, a scientific German manufacturer, speaks thus impartially.

"The technics of the beet-root sugar industry are being visibly developed, the cultivation of the root is improving, its saccharine richness increasing, and the percentage of sugar extracted becoming greater, whilst the costs of production are diminishing, yet the beet-root sugar industry ought to have no distant future, for it is only the want of knowledge and of the application of technical improvements by the cane sugar producer which have so long prevented the latter from making all competition of beet-root sugar impossible. The time will come when the cane sugar industry will be carried on with the same intelligence as that of the beet-root, *and then the days of the latter will be numbered.*"

But at present we need not anticipate so dark a future for the sister industry. There is still room enough for both branches of the sugar manufacture, as a few statements will show.

The whole production of sugar in all the quarters of the globe, may be fixed in round numbers at 2,400,000 tons. The yearly increase of consumption is estimated at 100,000 tons. The consumption varies in different countries according to the manners and pecuniary condition of the inhabitants. An English trade journal has lately published some statistics relative to this, in which the consumption of Australia is given as from 56lbs. to 80lbs. per head per annum, and in the Netherlands at only 28lbs. per head. I will take neither the highest nor the lowest of these, but as a medium, that of England, viz., 40lbs. per head. If the general consumption increases to this, and the constant increase of population is considered, then four millions of tons will be required for Europe alone, (nearly double the world's production) instead of only about one million tons as at present, of which the beet-root sugar industry supplies about half.

We may here also glance at Cuba, which last year produced 600,000 tons. Whether this rich island be annexed to America, or whether the "Pearl of the Antilles" be *not* lost to Spain, the emancipation of its slaves is inevitable. Even before the overthrow of the Spanish monarchy, the Royal Council had resolved on emancipation, and the government sprung from the revolution will certainly not maintain slavery.

Experience teaches us that on the abolition of slavery great numbers of plantations are abandoned. As a rule, the emancipated labourer has no cheerful recollections of plantation work, and generally seeks a subsistence by cultivating a small plot of ground for himself if he can obtain it; and in Cuba, with its 400,000 slaves, about half of whom are employed on the sugar plantations, it will be no easy matter to find substitutes for the manual labour which will then be withdrawn.

But we neither wish, nor do we need to build our hopes of prosperity for the sugar industry of Java on the ruin of other colonies, or on the decline of the beet-root sugar cultivation. A more

agreeable prospect is opening, should the competition in Europe become stronger. A quarter of the world full of youth and giant strength (Australia) lies not far from Java. On this head I will quote the words of the Chamber of Commerce at Batavia.

"By report of the 7th December, 1864, No. 140, we have referred your Excellency to the remarkably rapid development, by which, especially in the last few years, the Australian colonies have been distinguished.

"In that same report we have shown, that while the competition of the beet-root sugar industry threatens to drive us from many of the European markets, our cane sugar in the course of time must find its natural outlet to Australia, the Western coast of America, and the Persian Gulf.

"We here mention Australia first. This country will, when the barriers that still impede the intercourse are removed, be the largest consumer of our products.

"We are strengthened in this opinion anew by the reading of the very interesting pamphlets which your Excellency sent to us, with the missive of the first secretary of government, on the 10th of April, 1865, No. 684.

"Among the pamphlets, the one entitled, 'Description of the northern territory of South Australia, by Edward A. Oppen,' is of especial importance.

"The writer, in his introduction, calls to mind how that it is scarcely 80 years ago that the first settlement at Botany Bay was established, consisting of a governor, with his official staff, a military detachment, besides 850 convicts of both sexes; how at present, even the European population may be estimated at 1,300,000 souls; how the total amount of the value of the export trade may safely be put down at £28,000,000 sterling, and that of the import trade at £25,000,000 sterling, or together, £53,000,000 sterling. Now these data are only faint indications of the amazing national riches of this vast continent, with its 25,000,000 sheep, and 5,000,000 horses, but they show the boundless resources of this luxuriant country which only await the industrious hands of a daily increasing European and Chinese immigration, to augment to an indefinite extent.

"Indeed, it is astonishing, what in the last fifteen years has been achieved in Australia; it is scarcely to be believed, that already the total trade in imports and exports, represents a value of not less than 636,000,000 guilders a year. It is humiliating to be obliged to acknowledge that our share in that immense movement is scarcely worth mentioning.

"This deplorable fact is by no means to be attributed to a want of enterprise in our commercial population; on the contrary, it ought to be a matter of wonder that, notwithstanding the existing impediments, our share, however insignificant in comparison with the immense sum just mentioned, has been as large as it is.

"One of these impediments which we have repeatedly pointed out is, the want of direct steam communication. Now the need of a direct rapid communication principally concerns the governments of New South Wales and Queensland, yet we cannot sufficiently urge the necessity of putting our hands to the work, and giving to the carrying out of the plan proposed the most powerful support. Especially must we try to get out of the isolation in which we still are, therefore we must now endeavour to direct the proposed line, between Singapore and Queensland, by way of Java.

"Then truly will Java be the centre of a busy traffic in passengers and goods between Australia, Singapore, China, and Europe. The trade between Australia and China particularly, promises to be, in the course of time, of great importance. In Australia, an important peaceable Chinese population is already to be found. The Chinese immigration has been impeded, but latterly it has been much more favourably viewed in Australia. By their industrious disposition, the Chinese contribute much to the continual development of that important part of the world.

"We must now take care that we be not so situated as when after the establishment of Singapore, that town (declared a free port) became the centre of a large trade, and we, at the eleventh hour, opened Rioiaw with a similar object, but with a most unsatisfactory result. Let us never forget the lesson we then received; for the case would be similar if now a *direct* steam communication were established between Australia and Singapore.

"We trust, that to the clear insight of your Excellency it will be evident, that we ought eagerly, with outstretched hands to accept the offer that is made to us, to make Java the centre of a steam communication, the commercial results of which must be of incalculable importance.

"Hitherto, we have confined ourselves to a commercial view of the subject; the political side of it deserves a no less serious consideration. Concerning it, we will nevertheless be brief.

"It requires no stretch of the imagination to assume that within fifty years, (and what is half a century in the life of a people) Australia will count a European population equal to the total of the present population of Java.

"A large part of the southern and eastern coast is already thickly peopled. Free immigration to the west of Australia will not receive any powerful impulse till the transportation of convicts thither shall have ceased, which the government of the mother country has at length been obliged to resolve on, after the serious representations of the united colonies of Queensland, New South Wales, Victoria, South Australia, and Tasmania.

"On the Victoria river, on the north-west coast, only a few days' steaming from Timor-Koepang, Palmerston, the capital of the northern territory was recently established by South Australia, in a district, which according to the reports of Leichardt, Gregory, McDonall, Stuart, Muellir, Wilson, Burke, Wills, Landsborough, and other travellers, offers unsurpassed boundless pastures for the breeding of cattle, and fields for agriculture.

"New discoveries of fruitful districts in this vast continent are made known almost daily. The idea that the interior could consist of nothing but a barren sandy desert, has already been exploded. Different travellers, among whom, those above mentioned, have traversed Australia from the south to the north, and from the west to the east; some have had to pay for their zealous service to mankind and science with their lives. But so much is certain, that Australia will, comparatively soon, become a country, whose population will exert a significant influence on the political theatre of Asia.

"On that population are bestowed the blessings of self-government; it possesses the right of general direct election of the members of the local parliaments; several of the deviations from the pure constitutional principle retained in England from former times have been discarded in Australia. Hence it is that the various religious denominations enjoy equal protection; that no dominant State Church, with richly paid bishops exists; that every one, whatever his religious profession may be, is eligible to the parliaments and the different official employments. In a word, the system of government there comes nearer to the American than to the English model. Thence also it may be, that the Australian population, in their love of adventure, and dangerous enterprises, have more of the Yankee than of the true Briton.

"This spirit will certainly display itself more and more in the same way, and it is not impossible that India, sooner or later will see an Australian Lopez or Walker appear on her shores. This now is what we must prevent; Java must not in the course of time, become for Australia what Cuba has for so long been, and perhaps still is, for the United States of America.

"How is that to be frustrated? According to our firm conviction, by a liberal trade tariff, by friendly advances, by close connection, by a direct intercourse by steam. If these works of peace be carried out, then the Australian and every other will be at liberty to come and trade here freely, without hindrances and difficulties placed in his way; then certainly, as the history of the world teaches sufficiently on every page, we need not fear any influence which the Australian population, perhaps sooner than we think, must exert on a great part of Asia in general, and our Archipelago in particular.

"Let us then try to direct the stream for good, that we may never become embarrassed by it; and therefore let us step forward and co-operate in the establishment of a direct steam communication, which will have such important results.

"In the same measure as we, towards the attainment of that object, have been opponents of a direct line from Timor, we take under full protection every plan that has for its basis a

direct uninterrupted steam communication between Java and America.

"After this explanation of our considerations, we trust that your Excellency will second such a plan effectually, and that your Excellency will be further convinced that the political and commercial interests of the country in which we dwell require it, and that all may be done for this purpose which lies within the reach and power of the Government."

It is true, the trade of Java seems still to have difficulties to contend with, as well as want of good means of communication, particularly as regards competition with the Mauritius, and the difficulty of furnishing to the trade those sugars, which, as it is said, are preferred in Australia. But this is not insurmountable, and as for the kinds of sugar, the industry of Java must be released from the fetters which covenanted definitions have laid upon it, so as to be able to respond to that demand.

Perhaps not immediately, but yet in the not very distant future, the sugar industry of Java will be able to be generous to her sister, and leave the western markets open to her, should she be able to satisfy all their wants fully; moreover, it is certain, that if the industry of Java need not fear to compete with the beet-root sugar in Europe, the latter cannot bear the freight charges to go and disturb the peaceful traffic of Indian sugar in the East.

But if the sugar industry of Java has energy enough, both as regards the strength of the soil and the cost of production, as well as the quality of its product, not to need to succumb to its rivals, whence those numerous complaints that we hear? What, then, are the causes of the distrust that is observed, of those sickly symptons, of that marasmus with which the sugar industry of Java seems to be threatened? Can it be true that it is doomed to stagnation or retrogression? Can it be, that this industry, however it may appear outwardly, is nevertheless suffering from decay, or is it rather true what one of the most eminent of the French papers lately said: 'Java est une vaste exploitation de l'etat; tant vaut le governement Neerlandais ~~tout~~ vaut la production'."

tant

METHOD OF SEPARATING LEVULOSE FROM INVERTED SUGAR.

By M. Dubrunfaut.

[Extract, communicated to *l'Academie.*]

In making known the exact composition of sugar inverted into glucoses composed of dextrose and levulose, we have briefly indicated divers methods of verifying our analysis, and effecting experimentally the separation of the two glucoses. One of these methods is based on the remarkable property possessed by lime of forming with levulose, at a low temperature, a crystalline insoluble compound, easily separated from the mother liquor which retains in solution the dextrose in soluble calcic combination.

This experiment, satisfactorily demonstrative of the composition of inverted sugar, has been admitted into the course of experimental instruction of the Faculty of Sciences of Paris. But, notwithstanding this authority, and the verifications made by MM. Pelouze, Mitscherlich, Magnus, Stas, Melsens, and others, our experiment has been recently the subject of a critique in the "*Comptes Rendus*," intended to prove it to be incorrect. We therefore believe it to be our duty to explain it in detail.

If we place in an experiment glass, 1 decilitre of a syrup containing 10 grammes of sugar previously inverted by the usual method, and when it has been reduced to a very low temperature add to it 6 grammes of hydrate of lime in fine powder, on quickly agitating it, in the first place a milky emulsion is produced, with a slight elevation of temperature, which must be corrected by the aid of a refrigerator, and brought to the temperature of melting ice.* The agitation favours the dissolution of the lime, and then the reaction characteristic of the experiment takes place immediately. The milky fluid forms itself instantaneously into a crystalline mass of such consistence, that the glass in which the

* This experiment answers very well at a temperature of about 60° Faht. without the intervention of ice; but the results are more perfect with the precautions we have indicated.

experiment has been performed may be reversed without any falling out.

The crystalline mass may then be placed in a closely-woven linen bag and submitted to pressure, by which the two parts are separated: the one solid remains in the bag, the other passes through, a nearly clear liquid. On examining these two products separately, when deprived of their lime by the aid of any acid (preferably by oxalic, sulphuric, or carbonic) which produces insoluble salts of lime, we find the two sugars so far perfectly isolated as to admit of the identification of all their characteristic properties.

The following is a simple verification of the results of the experiment we have described, made with the aid of the numbers furnished by Soleil's saccharometer, of which the graduation, as is well known, expresses the rotations equal to hundredths of a millemetre of rock crystal perpendicular to the optical axis.

Ten grammes of cane sugar dissolved in 0·1 litre [of water], gives through a tube of 0·2 metre a rotation of 60° to 61° to the right. This solution inverted gives 21° to 22° to the left, at a temperature of 57° Faht.

The mother liquor of our experiment, treated by carbonic acid, gives on optical examination a rotation of 16° to the right at 57 Faht., which becomes 18° at a temperature of 185°. The difference between these two observations is due to the levulosate of lime, which is slightly soluble in the dextral glucose.

The levulosate of lime left in the bag, when diffused through 0·1 litre of water, *i.e.*, reduced to the same volume as the primitive liquid, then decomposed without heat by carbonic acid, gives a saccharine solution which, on optical examination, shows at a low temperature a rotatory power of 44 to 45° to the left, and at a temperature of 125 Faht. of 33° to 34 to the left. The sugar contained in this last solution is thus obviously pure glucose, and the quantity separated plus the very small proportion retained in the mother liquid, corresponds to the composition we have assigned to inverted sugar. With regard, then, to the separation of glucose, the experiment shows a degree of perfection, of which immediate organic analysis affords few examples.

This levulosate [of lime] is perfectly crytallized in small needle like prisms, which possess a double refraction. They are only soluble in pure water to the extent of ·03 per cent. They are very susceptible of modification at a temperature of 100 to 120° Faht., and still more at 212°, but at freezing point they may be kept for some hours without perceptible alteration. To conclude, these facts are analagous to those described by M. Peligot respecting dextral glucose.

In an experiment made as we have described, conducted as rapidly as possible, what is known as the glucose transformation under the influence of lime is very slight, for the precise hydrometer of M.M. Boudet & Boutron only detects *traces* of lime in the syrups, after the completion of the carbonic treatment followed by heating to ebullition.

It is unnecessary to state after these explanations that our experiment must not be made carelessly, nor without those precautions imposed by the known facts respecting the modifications glucoses are subject to under the influence of heat and alkalies.

Our method of separating the levulose by means of lime is so exact and precise, that it may be effectually applied in the detection of levulose in fluids containing less than 1 per cent. It may be usefully applied to the analysis of fruit sugars and of all products which contain inverted sugar, such as honey, cane molasses, &c. The great importance of inverted sugar as an agricultural production and as an article of food and manufacture adds no small interest to a process which permits of being carried into practical application, as does this analysis which we have effected in the laboratory.

Experiments made by us assign to levulose a sweetening property at least equal to that of cane sugar, whilst that of dextral glucose is very inferior.

It will doubtless be an important economical result to be able to separate grape and fruit sugars into two products diversely useful; the one as sugar proper, able to replace cane sugar in the form of a syrup, the other as a substitute for glucose starch, for manufacturing purposes.

BEET-ROOT SUGAR.

(*From the Chemical News.*)

When the Berlin apothecary, Marggraf, in the year 1747, made known, at a meeting of the Royal Prussian Academy of Sciences, the fact that the beet-root contained sugar identical with that derived from sugar cane, and that he had obtained, by means of alcohol, 6·2 per cent of sugar from the white variety of beet, and 4·5 per cent from the red-coloured root, he certainly did not dream that, within a century after his discovery, the manufacture of beet-root sugar would have become one of the most extensive of what is very properly termed, in the German language, *landwirthschaftliche Gewerbe*, but for which no very good translation can be given. It is too much the fashion to take it for granted that manufacturing industry ought to be chiefly confined to larger centres of population; but this notion is not entertained on the Continent, where, beside beet-root sugar making, the preparation of madder and various derivatives therefrom is conducted in the country, rather than in towns. This is also the case with the distillation of spirits from wine, as that obtained from various other sources—viz., potatoes, beet-roots, cherries, &c.

The proposals made by M. Marggraf to obtain sugar from beet-roots on the large scale did not then meet with any success, owing to a variety of concurrent causes, among which may be mentioned the cheapness of cane sugar, imported into Germany from this country and Holland. About the end of last century, Messrs. Achard and Hermbstädt again called attention to this subject, and succeeded on a sufficiently large scale in obtaining from beet-roots about 6 per cent of crystallised sugar and 4 per cent of molasses. It was, however, mainly due to the political disturbances and wars of the latter end of the last and first fifteen years of the present century that the manufacture of beet-root sugar was entered into commercially. This was principally due to the encouragement of Napoleon I., aided by the eminent judgment and sound scientific knowledge of one of his ministers—the famous Chaptal. It is true

that, almost immediately after Napoleon's fall, the beet-root sugar industry collapsed—but only to be revived on sounder scientific and mercantile principles, its temporary collapse being partly due to the protective tariffs made in favour of colonial sugars; whilst, in some countries, beet-root sugar making was practically prohibited, also, by absurd and injudicious excise regulations.

The plant known as *Beta maritima* (an unsightly biannual vegetable, which grows wild on the coast of the Mediterranean in Spain, Dalmatia, and some parts of France) is the mother plant from which the sugar-yielding beet has been derived. The well known red beet is a different variety of the same genus. The beet has been an object of regular cultivation as a suitable cattle fodder only from the beginning of this century, since which time several varieties have been obtained, partly as a result of cultivation, partly, also, as a consequence of climate and soil. The *Beta cicla*, or so-called white Silesian beet-root, is considered by many as the best variety for the production of sugar. This root, as well as the other varieties, is a biannual plant. The first year after sowing it only produces rootlets and leaves; in the second year of its growth, the root becomes developed; and, were it not that this vegetable cannot very well stand frost, the best period for its gathering would be in the spring following its second winter. This condition, however, cannot be complied with, and the crop is gathered in the autumn. The weight of the crop of roots gathered from one hectare varies, as might be expected, considerably; but the following figures may give some idea of this subject:—In Austria, from 416 to 580 cwts., yielding from 3080 to 4336 lbs. of sugar; Bohemia, from 448 to 580 cwts., yielding from 3344 to 4640 lbs. of sugar; Prussia, about 720 cwts., yielding about 5344 lbs. of sugar; France, 596 cwts., yielding 4464 lbs. of sugar. The composition of a good kind of the *Beta cicla*, in 100 parts, is:—Water, 83·5; sugar, with a trace of dextrine (about 0·1), 10·5; ligneous fibre, 0·8; albumen, casein, and other albumenoid substances, 1·5; fatty matter, 0·1; organic substances—viz., pectine, citric, and pectic acids, a substance which, in contact with air, assumes a rose colour, asparagin, oxalates and pectinates of lime,

potassa, and soda; inorganic salts—viz., nitrate and sulphate of potassa, chloride of potassium, phosphate of lime, and magnesia, all together 3·7 per cent. It is evident that the juice obtained from a plant of that complex composition is a somewhat difficult fluid to deal with for obtaining sugar therefrom; and, in order fully to illustrate the triumph of well-applied science in this respect, we quote, for comparison's sake, the percentage composition of sugar-cane:—Sugar, 17·8; water, 72·0; cellulose, 9·8; saline matter, 0·4.

There are various processes in use for obtaining sugar from beet-root; but the following is an outline of the general mode of operating:—The roots are dug up, and the head bearing the leaves (which serve together as fodder) is cut off commonly on the field. The roots are then carted to the sugar work, and there washed by machinery, it being essential that neither clay nor pebbles should remain adhering, since these might injure the machinery by which the roots are next made into pulp, by being torn up by very sharp circular saws, placed close together on a revolving cylinder, making from 1,000 to 1,200 revolutions per minute. The pulp is placed in bags made of a very strong linen tissue, and from twenty-five to fifty of these bags are placed on each other on the movable plate of a hydraulic press, care being taken to place between every two bags a frame wicker-work or perforated tinned-iron plates. The pressure which can be applied averages from 500 to 700 lbs. per square inch; generally the pressing process is repeated, sometimes with, sometimes without previous moistening of the cake, which, in some cases, is also broken up again. Before we follow the juice obtained by this pressure, we may pay a moment's attention to the cake obtained after it has been submitted to repeated pressure. It exhibits a hard, somewhat plank-like appearance, varying in size with the size of the press-plate, and about ½ or ⅝ of an inch thickness. It contains, according to an analysis made at Hohenheim*:—Water, 15·61; ash, 1·27; cellu-

* This place is situated near Stüttgart, in Wurtemberg, and is one of the largest and the best conducted agricultural colleges in Europe. It is fitted up, not only for theoretical, but also for practical instruction, and contains a model beet-root sugar work, brewery, distillery, and other manufactories belonging to the class termed, in Germany, *Landwirthschaftliche Gewerbe*, on a sufficiently large scale for practical use.

lose, 1·47; sugar, 1·72; carbohydrates (starch, &c.), 2·84; proteine compounds, 0·28; together, 23·2. To which add, to make up the 100 parts of beet-root, 76·8 per cent of juice, containing:—Water, 65·95; sugar, 10·17; carbohydrates, 0·63; proteine compounds, 0·58. The cake is used as a fodder for cattle, or, in some cases, for the manufacture of brandy, vinegar, and, last, but not least, for the manufacture of paper, for which it is increasingly in demand.

The juice, as it runs from the press-plate, is led, by means of gutters, to what is termed a *monte-jus*, and by its means (by steam) forced up to the defecation-pan, wherein it is rapidly heated, by means of steam (the pan being jacketed), to 85°. This temperature having been reached, a thin milk of lime is added, and the fluid thoroughly stirred up. The lime saturates the free acid present in the juice, and precipitates as well as decomposes the albuminous substances, ammonia being consequently evolved. In order that the lime should act properly, it is necessary to increase the heat, which is raised to near the boiling point of the fluid. The quantity of lime added depends upon the quality of the roots, but is generally about from 1 to 2 lbs. for every 100 litres of juice. The liquor in the defecation-pan is run off clear from the supernatant scum, by means of an ingeniously-contrived tap, and, previous to reaching the animal-charcoal filters, the fluid is filtered through a peculiar kind of flannel, made on purpose. The defecated juice is not a pure solution of sugar; it contains saccharate of lime, free sugar, free potassa, soda, and some ammonia; small quantities of organic nitrogenous substances, and sulphate and nitrate of potassa. The removal of a portion of these impurities is effected, in many instances, by filtration through animal charcoal, next submitted to the action of a current of carbonic acid, whereby the saccharate of lime is decomposed; and the clear liquid is evaporated to a density of 24° to 25° Beaumé (sp. gr. 1·199 to 1·210), and again filtered over animal charcoal, in order to remove from the liquid (technically, *clearsel*) colouring matter and other impurities. The filtered juice should have the colour of pale sherry, and be free from any suspended impurities. The filtered liquor is next evaporated to a

density of about 42° Beaumé (sp. gr. 1·412). This evaporation is best performed in a vacuum-pan. When the proper degree of concentration is attained, the thickish magna, (a mixture of crystallized sugar and syrup or molasses) is run into a copper pan, technically termed a cooler; but this is so far a misnomer, as the contents of the pan are heated by steam to a higher temperature (above 120°) than was attained in the vacuum-pan. The contents of the pan are kept in constant motion, by means of stirring, while a gang of men are busy carrying the pasty mass to the sugar-loaf forms, in order therein to solidify, and to be deprived of adhering syrup by being washed with a solution of pure sugar, sufficiently concentrated for it not to dissolve any crystallizable sugar, while effectually removing the molasses. Instead of this rather expensive process, which yields refined sugar, it is often omitted, and in its stead is substituted the use of the centrifugal machine, or, also of the so-called Schutzenbach boxes (iron tanks, with a false bottom made of wire-gauze, upon which the magna, after it has been heated in the coolers, is run), and there left for several days, until the molasses have entirely run off; the produce being raw beet-root sugar, which is not fit for consumption until it has been refined, even if its colour is only pale yellow.

The molasses from beet-root sugar are unfit for use as sweetenings, owing to the large quantity of mineral salts they contain. According to Meitzendorf, these molasses consist, in 100 parts, of:—Water, 10·8; mineral salts, 10·5; proteine compounds, 9·8; sugar (cane-sugar and non-crystallizable sugar), pectin, fatty matter, caramel, and other undetermined organic substances, 68·9. This material is employed for the manufacture of spirits, which, however, are not at all agreeable to the palate, but might be rendered pure by re-distillation with quicklime and the use of freshly-ignited wood-charcoal. The residue of this distillation is a valuable source of potash. In Russia and some parts of Silesia, the molasses are used, along with other fodder, for the cattle—a practice which deserves encouragement.

The Continent of Europe contains 1184 beet-root sugar works situated in Germany, France, Russia (inclusive of Poland), Austria,

and Belgium. There are, perhaps, scattered over the rest of Europe, some dozen more of these works; but their production does not materially add to the 4,475,000 cwt. of beet-root sugar annually produced by the works above named. It is evident that, in countries where labour is cheap, and whose inhabitants, but for the beet-root, would be dependent for their supply of sugar upon countries which possess colonies, or dependencies where sugar-cane can be grown, the cultivation of beet-roots intended for the manufacture of sugar is a decided boon. In some cases, objection may be raised to this industry, since it cannot be denied the extensive culture of such crops as, for instance, beet-root, tobacco, madder, &c., may interfere, to some extent, with the cultivation of cereals. Yet, however cogent this objection (which has, also, been several times brought forward against the extensive cultivation of sugar-cane in hot climates), it is an undeniable fact that the rural populations in Europe derive great benefit from this industry, which keeps them suitably employed during the winter months of each year; and the results obtained fully prove that beet-root sugar can hold its ground, and compete successfully with colonial sugar when placed on equality therewith.

As regards the United Kingdom, it cannot but cause some astonishment, that a country ranking first in agriculture, and doubly so in everything relating to manufacturing industry, should have hitherto lagged behind in the successful carrying out of this industry—a fact the more to be wondered at since the cultivation of root crops is very extensively carried on, and the beet-root residues may serve as food for cattle even better than the roots purposely cultivated for that purpose. Agricultural labourers can (as instanced by Continental experience) be readily taught the operations of the beet-sugar manufacture; and the skilled supervision does not require more than, at the utmost, half-a-dozen men. In France, Belgium, and Germany, women, as well as men, are employed in these works. As to climate, excepting the central and northern parts of Scotland, and the high moor grounds, the United Kingdom is as favourably situated for the cultivation of beet-root for sugar manufacture as any portion of the European

Continent; while the higher standard of agricultural efficiency in this country would greatly tend to secure good crops with existing system of rotation. As regards the duty on sugar, this is now equalised with that payable in the neighbouring countries—France, Belgium, and the Netherlands. So that, if the matter were to be properly taken up, and economically carried out, with due foresight, and there were brought to bear upon it that practical scientific knowledge which has raised, on the Continent, this industry from a puny infancy to the full strength of vigorous manhood, there is no doubt that it might become a source of great improvement and well-being to the rural population of this country.

PRACTICAL OBSERVATIONS ON CANE MANURE.—No. I.

By Dr. T. L. Phipson, F.C.S., London.

Member of the Chemical Society of Paris.

To the sugar planter the question of manure is becoming more important every day, and any practical observations upon a subject which affects to so great an extent the future prosperity of our West Indian colonies cannot fail, I believe, to have a certain degree of interest at the present moment.

During the last quarter of a century the science of Agricultural Chemistry has made very rapid strides, nevertheless, the action of manures upon the living plant is no better known physiologically than that of medicines upon men and animals. Not long ago we thought with Baron von Liebig, that by burning a plant and analysing the ash, we not only learnt what the plant derived from the soil, but the food necessary to render that plant luxuriant in a given soil. However, when Liebig asserted that the mineral ingredients found in plants were its only true and natural food, Boussingault (who, with the venerable Dr. Mulder and Sir H. Davy, must be looked upon as one of the fathers of Agricultural Chemistry) simply refuted the theory by applying the ashes of farmyard manure and an equivalent of farmyard manure itself, side by side,

upon the land. The latter gave a luxuriant crop; the former produced nothing. We shall see presently that the burning of a vegetable to procure the ash renders the mineral food it naturally contains almost useless.

More recently the laborious researches of Mr. Lawes and Dr. Gilbert have weakened the faith of agriculturists in mineral manures, though Mr. Lawes himself has long been a manufacturer of them, and at the outset of his agricultural researches took out a patent for making superphosphate. Have the results obtained by these gentlemen overthrown the fact, originally put forth by Liebig, that the mineral substances found in the soil and in the crops are of the greatest importance to the agriculturist?

Certainly not! These researches have merely shown once more, that nitrogen is likewise necessary to vegetation, and in their experiments of some twenty years' duration, Messrs. Lawes and Gilbert have come to the conclusion that *the largest crops were obtained when the mineral and nitrogenous manures were employed together.*

We allude more particularly to the researches made upon wheat, a plant of the same family as the sugar cane. Both are plants of the grass tribe, but the one is cultivated for the *seed*, and the other for its saccharine *juice*. Turnips, on the contrary, are grown principally for the roots, and it has been found by direct experiments that acid superphosphate is a very advantageous manure for this crop. But should we send out turnip manure to the sugar cane? We think not. It seems rather preposterous, at first sight, to apply an *acid* manure to ensure the production of *cane sugar*. The action of acids, especially mineral acids, upon this product is too well known to sugar manufacturers to need comment here. Does an acid manure in the soil act likewise? Probably it does, but the plant can only absorb the acid to a very slight extent.

Direct experiments, extending over a long series of years, have shown that superphosphate alone does little or no good to wheat; how can we expect that it will affect the sugar cane? It contains a large amount of free acid which the plant cannot touch until it is neutralized at the expense of the lime or potash in the soil. It is,

therefore, to a certain extent, an exhaustive manure; it is also deficient in potash and ammonia. In using superphosphate for the cane, it must therefore be largely mixed with salts of ammonia, Peruvian guano and chloride of potassium, or silicate of potash, or with any refuse animal matter or stable manure that may exist on the plantation.

Several of my correspondents have told me that cane trash is burnt, and that the ash is restored carefully to the soil in almost all the West India islands and in Demerara. Unfortunately, this cane trash is used as fuel, and we cannot expect to get work twice out of the same material. By burning the trash, its quality as manure is seriously deteriorated, the silica and the lime salts which it contains in a soluble form are thereby rendered insoluble, and more or less completely unavailable; its nitrogen is of course lost by combustion. By pressing it into a moist heap, and allowing it to ferment as our stable manure does at home, a most valuable manure would be obtained, rich in nitrogen, rich in potash, phosphorus, sulphur, and silica, all in an available form. But it is burnt, it is used as fuel, and we cannot, as I have just said, expect to get work twice out of the same material.

Sulphate of ammonia, largely employed in Demerara and elsewhere, acts as a powerful stimulant upon all graminaceous plants. With regard to the sugar cane, it has the advantage of supplying both sulphur and nitrogen, but nothing else. Its immediate effect is the rapid rise of the green cane, and consequently the production of a watery juice, poor in sugar. It is, moreover, a highly exhaustive manure, causing the plant to take up lime, potash, and phosphoric acid from soils well nigh exhausted, and giving, *for the time*, the appearance of extraordinary fertility. It should never be used without a due admixture of phosphates and potash salts. In my next I will refer to some other experiments, and will say a few words on cane soils, and on the best means of improving those which are partially exhausted. If anyone should ask me, "Can Agricultural Chemistry, in its present somewhat uncertain state, prescribe the proper manure for a given soil in which cane is grown year after year in succession?" I must reply, "Certainly

it does." I will endeavour shortly to point this out in plain language, and independently of any particular theory, relying for my conclusions on the results of direct experiment.

Analytical Laboratory, Putney, London, S.W.,
15*th February*, 1870.

ON THE ANALYSIS OF ANIMAL BLACK.

By M. Gaston Tissandier.

(*From the Chemical News.*)

The consumption of animal black in sugar factories is very considerable; and this product now plays a prominent part in commerce. After having been used in the clarifying of sugar, animal black is sometimes employed in agriculture; but on this point we shall examine it more particularly in speaking of manures.

Ash.—The sample to be analysed is ground and sifted; 2 grms. are taken and calcined in a platinum crucible till the perfectly white residue contains no further traces of carbon. This residue, when weighed, gives the proportion of ash contained in 2 grms. of material. The carbon and moisture are given by difference. Care must be taken to moderate the heat in this calcination, so as not to decompose the carbonate of lime contained in the ash.

Carbon.—5 grms. of animal black are dried at 110° in a stove, or in a paraffin bath: the loss of weight gives the moisture, which, subtracted from the loss by calcination, furnishes the proportion of carbon.

Silica.—The ash contained by the calcination of animal black is dissolved in water acidulated with chlorhydric acid; it is slightly heated, and the insoluble siliceous remainder is filtered and weighed.

Phosphate of Lime.—To the filtered solution is added a slight excess of ammonia, which precipitates all the phosphate of lime $PO_5, {}_3CaO$); it is filtered, and the precipitate is dried, calcined, and weighed.

CARBONATE OF LIME.—The liquid, separated by filtration from the phosphate of lime, contains carbonate of lime, which is precipitated at the boiling-point by oxalate of ammonia. The precipitate of oxalate of lime is collected; this it is well to filter and wash by decantation, pouring the washing-water on the filter. The calcination of this precipitate necessitates, as is well known, some precautions. The oxalate of lime must be heated to a sufficient temperature (approaching red heat) to transform it into carbonate of lime; but the heat must not be so great as to decompose the residue of carbonate of lime. After having weighed the carbonate of lime, the operation may be controlled in the following manner:—The precipitate is moistened with sulphuric acid; it is calcined, in order to get rid of the excess of this acid, and the sulphate of lime obtained is weighed. This amount ought to correspond with the quantity of carbonate of lime, if the operation has been properly executed. Animal black contains traces of magnesia, which can be estimated in the form of ammonico-magnesian phosphate.

SOLUBLE SALTS.—50 grms. of animal black are weighed and thrown into a little stoppered flask containing about 50 c. c. of distilled water; this is well shaken for a few minutes, and then filtered. The insoluble residue is re-digested in a fresh quantity of water; and this is repeated several times, so as to eliminate the whole of the soluble salts. The filtered liquid is evaporated over the sand-bath in a little porcelain capsule; the dry residue is weighed, and its weight gives the proportion of soluble salts. These salts consist of alkaline chlorides, sulphates, and carbonates; they also contain traces of sulphate of lime and sulphide of calcium.

COMPOSITION OF ANIMAL BLACK USED IN SUGAR REFINING.

Substances Estimated.	I.	II.	III.	
Water	2·00	1·37	1·21	Loss on calcination.
Carbon	8·42	9·90	11·12	
Carbonate of lime	14·92	13·80	12·22	Ash.
Phosphate of lime	72·50	72·25	74·43	
Silica	1·80	2·50	0·40	
Soluble salts	0·36	0·18	0·62	
Total	100·00	100·00	100·00	

SUCRATE OF HYDRO-CARBONATE OF LIME FOR SUGAR REFINING.

IT appears that an important modification of the carbonatation process has been in use for some months in one of the largest refineries in France, that of *MM. Sommier & Cie.*, of Villette, an establishment turning out 8,000 loaves of sugar per diem. In a recent number of the *Journal des Fabricants* there is a full account of the process there carried out, which we briefly summarise, as a literal translation would be too long for our pages.

The inventors of the process, MM. Boivin and Loiseau, have been long noted for their researches on sucrates. Some years ago, they, as well as M. Dubrunfaut, recognised the existence of a thick transparent gelatinous coagulum, which is formed by heat in a combination of definite proportions of sugar, lime, and carbonic acid. It is this substance which has been applied successfully by MM. Sommier & Cie. in the refining of 100 tons of sugar per diem.

The actual application of the process is carried out in the following manner:—

The first operation consists in forming with the washings of the refinery, and the addition of some syrup, a saccharine solution of a density of 20° Baumé, to which liquor hydrate of lime is added, at a temperature not exceeding 104° Faht., which must be then reduced to 76° Faht. The lime is intimately mixed with the liquor by means of a mechanical agitator, which at the same time aids in reducing the temperature. Carbonic acid is then introduced into the mixture, which, after the formation of abundant froth, is changed into a gelatinous mass, giving birth to a sucrate of hydro-carbonate of lime, an insoluble compound containing sugar, lime, and carbonic acid. It is this compound which becomes soluble in the presence of a larger quantity of sugar, that is used in definite proportions for the purifying of syrups and raw sugars.

In MM. Sommier's refinery the raw sugars are melted in vacuo,

the pans being supplied by elevators; when melted, the contents of the pan are sent to the clarifying copper, where, instead of blood and fine charcoal, sucrate of hydro-carbonate of lime, prepared as above, is added. The syrup, of which the usual density is 30° Baumé, is then carried to the boiling-point, when the following change takes place:—the foreign substances decompose the sucrate of hydro-carbonate of lime, which gives up to them its insoluble base, carbonate of lime in its naissant state, the well-known mechanical purifying agent in the *carbonatation trouble*. The free acids which are formed in the syrups, the gummy and albuminous, as well as the soluble nitrogenous substances, the ammoniacal, potassic, and sodic salts, and, lastly, the colouring matters, are decomposed or carried away by the lime, which also destroys the uncrystallizable sugar, of which the coloured derivatives are combined with the hydro-carbonate of lime, and are precipitated.

The use of lime and carbonic acid in only just sufficient quantity necessary to purify the syrups completely is one of the advantages of this system. When the boiling is completed, the syrup is passed through ordinary bag filters, and the filtered liquid of the usual density of clarified syrup is saturated by an injection of carbonic acid, which precipitates any excess of lime; then another boiling drives off all the carbonic acid remaining in the syrup; a second bag filtration then takes place, and the boiling liquor is passed at a density of 30° on to granular charcoal.

The washing of the filter bags is methodically conducted by means of three series of filter presses and a special apparatus; the washings serve for the preparation of the sucrate of hydro-carbonate of lime. The coloured deposit is quite free from sugar, and is of no value but for manure.

Amongst the advantages claimed for this process by its inventors are the elimination of the colouring and other organic matters; the destruction of the uncrystallizable sugar, which in ordinary processes is a cause of fermentation; the suppression of the use of blood and of fine charcoal, and of the use of the centrifugal as a preliminary in the working of low sugars; a considerable saving

in the quantity of granular charcoal required, great facility in working, more beautiful products, and increased returns.

At present the process is only applied to the *refining* of cane and beet-root sugars, but its inventors are sanguine that it will be equally useful, and give as beneficial results, in both colonial and beet sugar *manufacture*.

We are not surprised to learn that MM. Perier-Possoz, Cail, & Cie., who, when Dr. Icery invented his new process, laid claim to it, as being patentees of all the sulphites, have claimed the method of MM. Boivin and Loiseau, as being merely an adaptation of the *carbonatation trouble*.

REPORT OF THE CONSUL-GENERAL FOR AUSTRALIA TO THE CHAMBER OF COMMERCE AT BATAVIA.

(From the Appendix to "The Sugar Industry of Java.")

I HAD the honour to receive your esteemed missive of the 10th January, No. 5, and in answer to it, beg you to accept my assurance that nothing will be more gratifying to me than to be able to contribute to the development of the trade between Dutch East India and this colony.

I shall be most happy to afford you such information as may be of importance to the trade between the two colonies.

In answer to your question, "Why cannot Java, with its sugars, compete with Mauritius?" allow me to remark, that it is not a positive fact that Java can *not* compete with Mauritius.

I readily confess, however, that for the present Mauritius enjoys the preference, and this is due to the high state of purity in which the sugars directly fit for consumption are shipped from thence.

This is not the case with the Java sugars, although we have seen incontestably fine sugars in the market here; the crystal is in general too small, the sugar is not quite white, and it is strown, in

places here and there, with small black particles, and is, besides, too dry, whereas the Mauritius, though "moist," never turns out "clotty," a fault which happens much too often with the Java sugars. Besides, the Mauritius sugars are bright and clear in colour, whether it be white, or yellow, or brown, the crystals are alike in size, and the "counter sugars" alike in colour: but with proper machinery, I think this, too, may be easily remedied. It is admitted, that Java sugar is much stronger than Mauritius sugar, and hence I may suppose that if the manufacturers applied themselves with more energy to the trade between Java and this colony, and employed the same methods as are in use in Mauritius, the Java sugars would be able to compete successfully with those of the Mauritius.

Another point that ought not to be overlooked is, that the smell of the Java sugar is much too strong, whereas that of the Mauritius has scarcely anything unpleasant in it. In my opinion, this also might be remedied by more careful operation.

The sugars of Java just now in the best repute are the strong white clayed, usually packed in "kranjangs" of about 140 lbs., known here by the name of "crushed Java loaf sugar;" this sugar is at present worth £41 per ton; the charges of sale, duties, freight, insurance, a month's warehousing included, amount to about £10 15s., so that the net yield would be £30 5s. per ton of 2,240 lbs.

Another matter is this: that, (if I am rightly informed) the sugars suited to this market have to be ordered before they can be procured. It is natural that, under these circumstances, a merchant should rather give his orders where he knows that the qualities wished for are to be had at once, while, at the same time, he is certain that he need pay no higher price for a quality of sugar that has to be worked up for him.

I have the honour, &c.,

(Signed) J. W. PLOOS van AMSTEL,

Consul-General.

SUGAR CULTIVATION IN CHINA.

The cane is generally planted at the beginning of winter; in the first place the canes intended for planting are cut off just above the root, and buried entire in trenches, in perfectly dry soil, the choice of which is considered very important.

Towards the middle of February, when the season is favourable, the canes are taken out of the ground in which they have been laid, the bark is stripped off, and they are cut into pieces about 6 inches long, corresponding to the distance between the knots. The pieces thus prepared are spread nearly close together on beds of earth, and covered with vegetable mould, care being taken to turn upwards the part from which the sprouts shoot. When germination has commenced, and the shoots are one or two inches long, the cane beds are frequently watered with manure water, and when the shoots have grown six inches, the plants are carefully raised and transplanted singly in the cane patches, for which care is taken to choose light loamy soil, such as is formed on the banks of rivers being preferred. The planter, to be sure of soil of suitable quality, digs a hole 4 or 5 feet deep, and, taking some of the earth from the bottom, carefully tastes it, and, if it is at all bitter, it is considered unsuitable for the sugar cane.

Fields open to the sun are selected as the most favourable, plains or plateaus being preferred to the hilly or mountainous parts, as the latter are more subject to frequent winds, which are unfavourable to the development of the cane.

For transplanting the young canes, beds of about 4 feet broad are prepared, and between these, furrows about 4 inches deep are ploughed, in which the plants are placed about 2 feet apart, and covered over with earth about an inch thick; as the shoots begin to appear, fresh earth is thrown over them, and then the weeding is commenced.

Thanks to the gradual raising of the level of the soil, the plant thrives, the roots penetrate deeply, and the cane plantations are able to resist the violence of the wind. During this period of their

growth the plants are watered with liquid manure, according as the soil may require it.

When the canes have attained a height of 2 feet, a peculiar kind of liquid manure is applied, produced by a decoction of the grains of the *Hou-Ma* (Sessamum. Oriental), or of the dry twigs of another shrub, the *Jun-Tai;* this manure, it is supposed, notably increases the yield of sugar from the cane. In consequence of the great care and pains taken, the canes are generally luxurious, and soon arrive at maturity. After the cutting of the crop, it is usual to plough between the beds, which operation cuts the lateral roots, and throws a great thickness of earth on to the central part, which requires protection from the frost or snow.

The sugar which the Chinese extract from the cane is taken to market in three different forms, called by them, "sugar made solid," "hoar frost," and "red sand." These distinctions are indicative of differences of quality, caused [it is said] by the different ages of the cane from which the sugar is extracted.

In the south of China, where there is no fear of frost, the canes may remain longer uncut, and a better class of sugar may be extracted from them than from the canes grown in the more northern provinces of Petcheli and Honan, where the cold is often very severe about October, and where, consequently, the cane needs very different treatment, as the juice loses all its value when subjected to frost. In these regions, all the operations of the extraction of the sugar are completed in about fifteen days; in fact, the planter has only the very limited time to work in comprised between the period of the ripening of the cane and the commencement of frost. In the south of China, the canes are left standing through the winter and cut at the beginning of spring.

According to Chinese authors, the sugar may be extracted from the cane in many different methods; but we will describe that used in the provinces where sugar cane is most cultivated.

In all cases they commence by crushing the canes between two rollers of hard wood, which are turned by buffaloes. The liquid sugar or juice flows into a wooden trough, by which it is conducted to a large earthenware cistern. To the juice, slaked lime is added,

in the proportion of 5 centimes per bushel liquid measure. The mixture is passed into coppers heated by a furnace, in which charcoal or wood is burnt. When the liquor has been clarified by defecation, it is transferred into a second copper, where it is concentrated to the degree necessary to ensure crystallization. The juice is boiled until yellow bubbles appear on the surface; and further, to be assured that it is completely concentrated, the operator takes a little on his finger, when it should congeal immediately.

When the action of the fire has been sufficiently prolonged, the boiled liquid is poured into barrels, where it solidifies in the form of impure crystals, very brown in colour. These crystals which are mixed with a blackish liquid, are passed into conical vases, the bottoms of which are pierced with a hole, rudely stopped by a wisp of straw; when these conical vessels are filled, the straw is removed, and the liquid which soils the sugar is allowed to escape by the opening at the bottom. The purification is effected by washing the sugar crystals with water containing argil in suspension. This removes the foreign matters mixed with the sugar, and by repeated washings of this the sugar soon takes a good complexion, and becomes nearly white.

The sugar at the top of the vases is the best and purest, that at the bottom being always grey and inferior; the whitest part the Chinese call European sugar, a tribute to the quality produced by Western makers.

ESTIMATION OF SULPHUR AND GYPSUM IN ANIMAL CHARCOAL.—M. Reichardt.—The main feature explained in this paper is, that animal charcoal may, and often does, contain considerable quantities of gypsum; but, besides this, sulphur, apparently in combination with carbon, in a similar manner as sulphur may be met with in coke. The estimation of the sulphate of lime is effected, either by boiling the material under investigation with pure hydrochloric acid, or repeatedly with a solution of pure carbonate of soda. The sulphur is estimated by fusion and ignition of the animal charcoal with pure nitrate of potassa, and in each case the sulphuric acid is estimated in the usual way.

COMMISSION ON DISTILLERY LEES IN BRITISH GUIANA.*

The manufacture of rum is an important branch of the colonial sugar industry, as, in its present position, distillation is generally (in many places) the most profitable means of utilizing the molasses as well as the refuse, especially where the vacuum pan is used. The question of how to dispose of the distillery lees has, particularly in Trinidad and British Guiana, been one of considerable difficulty; in some other parts of the West Indies, as in Jamaica and Barbadoes, it is of less moment, not only because the quantity of rum distilled is smaller in proportion to the sugar manufactured, but because the method of preparing the wash is different, and the quantity of lees comparatively insignificant; but in the colonies first named the quantity is very great, and the difficulty has been not so much how to utilize, but how to get rid of the lees. Hitherto, the lees and other refuse have been run into trenches, whence, during the heavy rains, they have found their way to the sea; but in dry weather they have become stagnant, and exhaled very noxious and offensive effluvia.

In British Guiana this nuisance had increased to such an extent that about a year ago the Governor appointed a Commission, "for the purpose of collecting information on the subject, and of devising some remedy." The report of the Commissioners was returned some months back, and has been printed in the form of a "Blue Book," of some seventy pages, of which the report itself comprises sixteen, the rest being evidence and suggestions, the whole being of a valuable and interesting character. The following extracts from the report will show the extent of the evil, and the necessity of some remedy being applied:—

* "Report of the Commissioners for enquiring into the practice of allowing distillery lees and other impurities to flow into and remain in the open trenches of the plantations, with the evidence taken by the Commissioners, and an appendix containing sundry papers bearing upon the subject." British Guiana, 1869.

"From the fiscal returns of the colony for the year 1868, the quantity of rum exported amounted to 27,776 puncheons, and for consumption in the colony to 749, in all 28,525 puncheons, of a capacity of 96 gallons each, or of 2,738,400 gallons of rum, of an average strength of 37·5 over proof.

"It therefore appears, that in the production of this quantity of rum there must have remained of spent wash fully 40,000,000 gallons to be got rid of.*

* * * * * * *

"The spent wash from the stills, when exposed to the action of the sun and atmosphere, rapidly decomposes, and undergoes putrefactive fermentation, giving rise to the elimination of various gases, and among them of sulphuretted hydrogen, from the decomposition of the vegetable albumen, which contains sulphur as one of its constituents; and it is this gas chiefly which constitutes the nuisance.

"The deleterious action of this gas on the animal economy has long been known. In its unmixed and undiluted state it is instantly fatal to animal life, and even when largely diluted to the extent of 1 in 5,000 of atmospheric air, its effects on persons breathing such an atmosphere for a few hours have been severe and dangerous.

"With regard to the mischiefs arising from the nuisance in question, we have to report that, from the extensive evidence taken by us as to the effects upon the health of persons living in an atmosphere tainted with the gas evolved from lees trenches, the following conclusions may be arrived at:—

"1. That the presence of sulphuretted hydrogen in the atmosphere to the extent in which it is often found in this colony, is prejudicial to health.

"2. That it does not give rise to any specific disease, yet,

"3. That it lowers the vital forces, as is evidenced by prostration, nausea, headache, loss of appetite, &c.

"4. That from its action the system is rendered less able to resist the attacks of disease.

* The amount of rum obtained is about 6 per cent. of the "wash."

"5. That its effects must exert an injurious influence on individuals during the period of acclimation."

From these passages in the report, and from the nature of the evidence of several of the witnesses, it is evident that the present method of disposing of the lees is so objectionable that we should be astonished how the colonists of British Guiana had borne with it so long, did we not remember how in many of our large towns "at home" the rivers, tolerated with complacency by the inhabitants, are often little better than immense stagnant ditches full of refuse even more deleterious than distillery lees.

The Commissioners have suggested a plan for the separation of the solid from the liquid portion of the lees, with a view of obtaining a useful manure without occasioning a nuisance, but they regret that they are "not in a position to report that it has been tested by actual experiment;" but happily they do not wait for the discovery of a remedy to recommend that the present method of disposing of the lees should be rendered illegal, and the following clause is the most satisfactory in the very able and exhaustive report:—

"But whatever may be the best means of utilizing lees, we are of opinion that the nuisance ought not to be allowed to continue. We think that after the lapse of a reasonable time, sufficient to enable the planting body to make their arrangements, it should be rendered illegal to pollute the water of estates' trenches with any lees or refuse from the stills or sugar works, leaving each individual planter to adopt his own method of complying with the law according to the circumstances of his particular case. And we think that the prohibition should extend to the formation of lees ponds, or swamps, in any but exceptional localities under special license, &c."

Doubtless, different methods of utilizing or disposing of the lees will be feasible in different localities and according to circumstances; the plan which is now being carried out on Mr. Crum Ewing's estates, as described by Mr. A. Crum Ewing in the last number of this magazine, appears to be one of the best, and the least open to objection: possibly the expense may render it

difficult of adoption by less wealthy proprietors. The use of some chemical disinfectant, whilst the spent wash is in the cistern, before being sent on the land, would probably completely prevent the formation of any noxious effluvia. The new disinfectant and manure, "Sulphite of Phosphate of Lime," lately described in these pages by its inventor, Dr. Gerland, seems likely to be well adapted to answer this end; it would also add materially to the value of the lees as a manure by the addition of the phosphate which it contains.

Further, it is not improbable that improved modes of culture and manufacture may tend greatly to reduce the amount of cane products which it is at present most profitable to utilize by distillation; and that the quality of the cane juice, which, we gather from the "Report," is very impure in British Guiana, may be improved, in which case there would be less molasses and of better quality. We note that one of the witnesses suggested the separation of the juice in the scum from the other matters, this would no doubt be a decidedly economical plan. We have been informed, that on one West Indian estate where rum was formerly made, that by passing all the scum of the clarifiers through bag filters, some thousands of gallons of juice are saved, whilst the deposit remaining in the bags is not of sufficient saccharine value for distillation.

CANE SUGAR IN MADDER-ROOT.—M. Stein.—The author states that the existence of cane sugar in madder-root has not been hitherto proved. This statement is, however, erroneous, since even about the latter end of the last century attention has been directed to the fact that madder-root, and especially the Zealand madder, is rich in cane sugar, containing between 14 and 16 per cent. The extraction of this sugar, without interfering with the tinctorial value of madder, and by means different from those whereby that sugar is now utilized, viz., fermentation and making of alcohol, is not elucidated, only discussed, in this paper. Since some 10,000,000 kilos. of madder are, at the very lowest estimate, consumed annually, and since the bulk of the sugar therein contained is utterly lost, there is a fair field of profitable experimental research still left open and untouched.

THE SUGAR DUTIES.

As the question of the sugar duties will probably be settled for some time to come before our next issue, and is consequently of especial interest at the present time, we transfer to our pages some letters on the subject which lately appeared in a provincial paper. The first was written, as will be seen, in reply to some editorial remarks in favour of a uniform rate.

To the Editors,

I am sorry to see your influential paper advocating the abolition of the present differential duties on sugar, and the imposition of one uniform rate of duty in their stead. I am sure, that were you practically acquainted with the manufacture of sugar, and with the working of the graduated duties, you would have expressed very different opinions. There is nothing which both the colonial sugar planter and the English sugar refiner would better like to see than the total abolition of all duties on sugar. If, however, this desirable end cannot at once be obtained, then both planter and refiner demand (and in this case the consumer's interest and their own are identical) that the duties shall be so arranged as to place the various qualities of sugar practically in relative positions with those which they would occupy if the duties were altogether done away with.

In considering this question, it must be remembered that cane juice contains very many impurities which must be removed before an article can be obtained fit to pass into our sugar basins. The question then arises, can these impurities be removed most economically by the planter or by the refiner? Before replying to this question, we must consider that in order to remove these impurities much costly machinery is required, and that this is very much more expensive in the colonies than at home; that much skilled labour is needed, and that this must be paid for at a much higher rate in the colonies than at home; that much fuel is required, and that here again the English refiner is far more favourably situated than

the colonial planter; and we have yet again this great fact to consider, that when the planter has got his costly machinery and his expensive skilled labour he can only employ them for three months, or at the most four months out of the year, while the English refiner can work on all the year round. There is, then, every reason to think that the refiner can separate the impurities from the sugar at least as cheaply, and probably much more cheaply, than the planter can. We want, then, duties which shall leave the refiner free to remove the impurities, if he can do this more cheaply than the planter, but which shall not prevent the planter from removing them if he can do it more cheaply than the refiner. If our duties attain this end, then they are such as are most to the consumer's advantage, since they protect neither planter nor refiner, but leave the work to be done by whoever can do it most cheaply. This end I have no hesitation in affirming most positively can only be obtained by a system of graduated duties. The law imposes a duty upon sugar. In any sugar refinery working up sugar of low quality, many tons of mud, most disagreeable in odour and most unsuitable for human food, are weekly extracted from the sugars under operation. Is it fair to charge duty upon this mud as if it were sugar? and yet this is what would be done if a uniform duty were to be re-established. It may be well to remind your readers that the present scale of differential duties is of comparatively recent date, that Mr. Gladstone was Chancellor of the Exchequer when it was first promulgated, and that it was only settled after much agitation of the subject, and after a hard battle had been fought by all interested in its settlement. Yet more, after its settlement in England there was a conference on this subject at the Hague between the representatives of England, of France, and of the Netherlands, for the sake of arranging for a common system of levying duties on sugar. The representatives of France and of the Netherlands came to that conference confident in the advantages of their own system, and sure of winning over the English representatives to their views. Yet they were in the long run convinced of the absolute justice of our scale of duties, and the result was the adoption of the English

differential scale by the International Sugar Convention of Nov. 18, 1864. For the present all the contracting parties are bound by the decisions of that convention. They are not bound to levy a duty on sugar, nor are they bound, if they levy a duty at all, to levy it at any particular rate per cent.; but they are bound to levy it according to the proportional scale then drawn up. When we ourselves have led the way in the path of reform, and having ourselves a scale of duties which is just to all concerned, whether planter, refiner, or consumer, have convinced other nations of the justice of our views, and have induced them to adopt them, it would be a pity to go back and abandon the path of justice because there may be a little difficulty (and, practically, the difficulty is very, very small) in the present method of assessing the duties. I trouble you with this letter because, as a sugar planter, as a manufacturer of sugar machinery, and as one who is brought into almost daily contact with sugar planters, sugar refiners, and sugar merchants, I am probably more conversant with this subject than are most of your readers.

I am, gentlemen, yours truly,

JAMES B. ALLIOTT.

Bloomsgrove Works, Nottingham, 19*th Jan.*, 1870.

MR. ALLIOTT ON THE SUGAR DUTIES.

TO THE EDITORS,

In your impression of Thursday last, is a letter from Mr. Alliott, giving his opinion as a planter and manufacturer of sugar refining machinery, that the present differential duties are much fairer to all parties than a uniform one would be.

To be either a planter or manufacturer of machinery is not at all necessary to understand the question; in fact, I doubt whether, being the latter, has not led Mr. Alliott to come to conclusions he would hardly otherwise have done. Mr. Alliott, if I am rightly imformed, is sole manufacturer of Mr. Fryer's Concretor, a machine for rendering the juice of the cane fit at a small cost, and in a very short time, for shipping to this country

for refining purposes. He is also largely interested, I believe, in making the centrifugal machines, so much used in refining moist sugar in this country. It is self-evident, therefore, that were the planters to send their sugars over in such a state, that the public would use them freely without passing through the refiners' hands, much of Mr. Alliott's machinery would not be needed. His evidence can hardly, therefore, be called perfectly disinterested. That there is another side to the question, viz., that of the skilful planter, which is identical with that of the consumer, I will endeavour to show.

Mr. Alliott's argument I understand to be that, as we must have a duty for fiscal purposes, then the fairest to all parties concerned is to have a graduated duty.

There can be no question that it is the interest of the consumer that the finest quality of sugar should be produced at as little extra cost over the lowest quality as science and skill can effect. Also, that it is impolitic and unjust by fiscal regulations to deprive a producer who uses skill and capital of the full natural advantage in force, that the public are willing to pay for his superior production.

That differential duties rob skill and capital of their fair return, and at the same time act as protective duties in favour of the producers of inferior sugars; anyone who will take the trouble to understand the question will readily see.

Supposing, for argument, that the price of the lowest quality of sugar, without duty, was 20s. per cwt., and that of the highest 35s.; it follows that 15s. per cwt. is the difference in value that the public are willing to pay for the superior in preference to the inferior quality, which may fairly be called the natural difference. Now, if a uniform duty of 10s. per cwt. be charged, they will both use pretty nearly in the same proportion, though all duties have a tendency to increase the value of the lowest quality, and to depress that of the highest, and the difference in value will still remain pretty nearly 15s. per cwt., as before. On the other hand, let a differential duty of, say 8s. per cwt. on the lowest quality, and 12s. per cwt. on the highest, be levied, and a very different effect is produced. The lowest quality will now sell for 28s. at least, duty

paid, but the public being willing to pay only 15s. per cwt. more for the highest quality when there was no duty, 43s. per cwt will now be its market value, thus leaving the unfortunate producer 31s. per cwt. after the duty has been paid, instead of 35s., which we have seen he would have received had there been no duty. This is what Mr. Alliott calls fair to all parties.

Now unless we suppose that the public will give more for the finest sugar in proportion to the lowest, when the price is enhanced at least 25 per cent. by a duty, than they would were there no duty, a supposition contrary to experience and common sense, it follows that the skilful planter must submit to be mulcted 4s. per cwt., or, what is more probable, look out for other markets where he is not fined for the use of skill and capital.

The practical effects of these duties are precisely what might have been expected. The imports of the fine raw sugars, so much esteemed by the public from their place of growth, has become small by degrees and beautifully less, till, as every good housewife knows, that it is only at a few shops they can be obtained at all.

There are other very serious objections to graduated duties besides those mentioned above.

The professed principle upon which they are based is supposed to be, that the duty shall be in proportion to the quality of the sugar; but as it is impossible to analyze each cargo, the duty is fixed by one of the custom officials in presence of the importer or his agent. Now, as no official with the best intentions to act fairly between the government and the merchant can possibly say where any one class actually begins, and where the other ends, it often happens that sugar of precisely the same market value will be charged one duty in Liverpool or Glasgow, and another in London.

Mr. Alliott first informs us that coal, labour, machinery, &c., being much cheaper in this country than in the West Indies, it is much more economical for the Saxon planters to send their produce over in a rough state, and for it to be refined again here, than it would be to make it fit for the consumer on the spot where it is grown. If so, why does he require a 4s. per cwt. protective duty for the inferior descriptions, and why would the smaller planters be ruined by a uniform duty?

Sugar has become in this country one of the most necessary articles of diet, especially to the poor, ranking in importance next to meat, and that a duty equal to 25 per cent. of its value should still be levied upon it is a disgrace to our fiscal legislation.

The duty question has too long been a plague to everyone interested in the article, and they should, the very first time the revenue will permit, be totally abolished; in the meantime if that is not possible, it is devoutly to be wished that a uniform duty may be substituted for the present complex and unsatisfactory system.

Yours truly,

J. B. H.

THE SUGAR DUTIES.

To THE EDITORS,

Immediately on my return home after some days absence, I hasten to reply to a letter from "J.B.H.," advocating a change in the present method of levying the sugar duties, which appeared in your impression of the 26th inst.

In that letter he asserts that it is not necessary to be either a planter or a manufacturer of machinery in order to understand this question. In this assertion he is undoubtedly right, but I think your readers will bear me out in the belief that some fairly intimate knowledge of a subject is required in order to enable *any one*, no matter how clever he may be, to pronounce a dogmatic and authorative opinion on it.

Before I proceed to explain more fully why graduated duties are just, and why one uniform duty would not be just, allow me to make a personal explanation rendered necessary by the imputations which "J.B.H." has seen fit to cast upon my evidence. He affirms that my views must not be adopted because I manufacture centrifugal machines, which are used by the English refiner, and he therefore concludes that I am influenced to leave the planter in the lurch, because my sympathies are with the refiner. He is evidently unaware, 1st, that when the colonial planter tries to make fine sugar, he, too, uses the centrifugal machine; 2nd, that notwith-

standing all the pains taken by the planter who wishes to make fine sugar, much of his produce passes after all into the hands of the English refiner, and thus is *twice* operated upon in the centrifugal machine, once in the colonies and once in this country; 3rd, that at the present time, for every centrifugal machine which I make for use in the English refineries, I make at least a dozen to be used by the colonial planters.

He next affirms that I am incompetent to offer an opinion because I manufacture Fryer's Concretor, which is used by the colonial planter, and which he evidently believes can only be employed for the manufacture of an inferior class of sugar. Here again his information is incorrect. As a matter of fact, Fryer's Concretor is quite as applicable where it is desired to make fine sugar as where the planter only desires rapidly, and at small cost to himself, to turn his cane juice into a material fit for shipment. Even if this were not the case, it would still be true that my firm manufactured sugar machinery long before Fryer's Concretor was invented, and that the system which I advocate is one that requires comparatively little machinery, while that which he advocates needs much machinery. True, Fryer's Concretor *will do* all that "J.B.H." says it will do, and it was for that reason my firm entered upon its manufacture, believing, as we do, that free trade, represented by graduated duties on sugar, will continue and that ultimately the planter will do as little as may be in the manufacturing department, and that, therefore, the simplest and cheapest machine, which is able to convert the cane juice (without injury to its colour or chemical constitution) into a material fit for shipment, will eventually be the machine most sought after. Thus we entered on the manufacture of the Concretor *because* we believed in free trade and graduated duties, and it is a gross mis-statement of fact to reverse this, as "J. B. H." has done, and to affirm that we believe in free trade and graduated duties because we manufacture Concretors.

This is a long digression on merely personal matters, but it will not have been altogether lost, since it has afforded the opportunity of showing that "J. B. H." has been altogether mis-informed as to

the methods in which the manufacture of sugar is carried on in the tropical world.

The radical error which "J.B.H." makes in his reasoning is, that he looks at low sugar and at fine sugar as he would at a low quality of tea and at a fine quality of tea; and he then supposes that by a little more care and skill *all* the sugar might be fine sugar. This is not the case. The planter takes a gallon of cane juice. He has two courses open to him. He may say, "I will make this into fine sugar," and then he will, if he be fairly skilful and his juice of fine quality, get $1\frac{1}{4}$ lbs. of good sugar, and $\frac{3}{4}$ lbs. of molasses, and other products; or he may say, "I will evaporate this cane juice in the cheapest and most economical way," and he will then get 2 lbs. of a lower class sugar with *no* molasses or other residuum. As the duties are at present arranged, the man who sent to England the $1\frac{1}{4}$ lbs. of fine sugar and the $\frac{3}{4}$ lb. of molasses, which he had made from his gallon of cane juice, would pay just about the same duty as the man who sent in his 2 lbs. of low class sugar, also made from one gallon of cane juice.

Your correspondent would hardly expect to impose as high a duty on molasses as on fine sugar. If this could be done, and if under that arrangement the colonial manufacturer of fine sugar could be *forced to send in his molasses, &c., as well as his fine sugar* (*two* impossible suppositions), then, and then only, a single fixed rate of duty would be just. . . . .

The duties on sugar are in fact exactly analagous to the duties on spirits. No one would think of levying the same duty on spirit ten or twenty degrees under proof as on proof spirit. Why then ask that the same duty should be levied on sugar ten or twenty degrees under proof (in other words mixed up with more or less extraneous matter, just as the low spirit *is low*, because it is mixed up with other matter which is not spirit), as upon proof (or in other words, perfectly pure) sugar? . . . .

Again, your correspondent asserts that it is impossible to analyse each cargo of sugar, to determine its real quality. As a matter of fact, many refiners *buy no sugar which they have* NOT *analysed.* If then it be possible for the refiner to *buy* his sugars from analysis,

why should it be impossible for the Government to levy its duties according to analysis? Why, indeed, should not a single analysis serve both to guide the Government in levying duty and the purchaser in offering a price? I am not now saying that it is worth while to make this change, for I believe that under the present system the duties are levied with substantial justice, but I *am* asserting that what "J. B. H." declares to be impossible is perfectly practicable; nay, is even easy, and that for other purposes it is done every day.

I am, gentlemen, yours truly,

JAMES B. ALLIOTT.

THE DUTY ON SUGARS IN THE UNITED STATES.

(From the American Grocer.)

THE present duties on sugars are as follows: On raw and brown sugar, not above No. 12 Dutch standard, 3 cents per lb.; on white or clayed, above No. 12 and not above No. 15 Dutch standard, not refined, 3½ cents per lb.; above 15 and not over 20, 4 cents per lb.; on refined, 5 cents per lb.; and on Melado, 2½ cents per lb.

The Congressional Committee on Ways and Means propose to reduce the duty and alter the classification as follows: Raw or Muscovado sugar, 2 cents per lb.; clarified sugar, 3 cents per lb.; refined sugar, 4 cents per lb. All sugar other than refined stove-dried, which has in the proper manner been advanced in quality above No. 12 Dutch standard in colour by being crystallized in vacuum pans, or clayed or liquored in moulds, or purged in centrifugal machines, or by vacuum process, or filtered through bone-black or its equivalent, shall be regarded as clarified sugar.

Molasses made from sugar cane was rated by the Committee to pay 5 cents per gallon—a reduction of 3 cents. Tank bottom syrup of sugar cane juice, melado, concentrated melado, or concentrated molasses, was fixed at 1¾ cents per lb.; provided that all syrup of sugar, syrup of sugar cane juice, melado, concentrated melado, or concentrated molasses, entered under the name of molasses, shall be forfeited to the United States.

Correspondence.

CANE CULTURE IN PORTO RICO.

To THE EDITOR OF "THE SUGAR CANE."

DEAR SIR,

In your last issue I notice that you complain, and that justly, of the lack of communications from practical men on topics connected with the culture of the sugar cane. It is very much to be regretted that persons competent to do so have not undertaken the task, and I would suggest that it does not arise from a lack of desire on their part, but from the extensiveness of the subject, few practical men having the time necessary to write to you on the subject in general, although many might do so were some particular branch brought, up for discussion. My object in writing is, that my example may be followed by others more handy in the use of their pen than I am and in the hope that my successful treatment of a *worn-out sugar estate* may prove useful to others.

Some eight years back I rented the estate "Constancia," lying on the coast, and adjoining the port of Ponce, consisting of about 570 acres of land, of which 220 acres were arable land, and 350 partly land impregnated with saltpetre not growing grass enough for pasture, and the rest mangrove thicket. My crushing is done with a steam mill, and my boiling in a set of open coppers, without any modern improvements; I clarify only with lime.

Crop being over in July, in this month I begin my ploughing, for which purpose I employ the largest sized American ploughs, they being of lighter draft than those of English manufacture, three yoke of oxen being able to close plough an acre in from 10 to 12 hours; this first ploughing is 8 inches deep. I now cross plough with an English plough, going 3 to 4 inches deeper. The furrows are now made 6 feet apart, and the plant tops placed in 1 foot square holes made with a spade, and from 6 to 7 inches deep, thus leaving loose soil below the tops. If the weather be wet, I lay down the tops in the hole; but if dry, I put them in with the crowbar standing up. The planting season extends from August

to March, and I try to get in the bulk of my crop in September and October, so that the young sprouts may have the full benefit of the then frequent showers. Canes well planted in these two months never fail to yield from 5 to 6 hogsheads (of 1,300 lbs. nett), and 33 per cent. molasses of finest quality, per acre. I manure with pen manure in the hole on planting, and when the sprouts begin to joint, put to each stool two ounces of Peruvian guano.

My work is performed by 60 yoke of oxen, and in their pen I place, well covered up by trash, all the offal I can procure, as well as spoiled cod-fish, herring, jerk beef, &c., which I purchase from the merchants at a low figure, as it would otherwise be thrown away, and in this manner I generally keep up a good supply of manure.

Hoping you may find these lines worthy of insertion,

I remain, yours truly,

Ponce, Porto Rico, 25th January, 1870. M. LEE.

DR. E. ICERY'S MONOSULPHITE OF LIME PROCESS.

To the Editor of "The Sugar Cane,"

Sir,

You give, in your last number, a translation of Dr. E. Icery's "Practical Instructions" for the application of the above process to the purification of cane juice. The method is undoubtedly a highly important one, and the paper will be read with interest by most of your readers; nevertheless, as some of the author's remarks are open to criticism, and as my own experience in connection with this subject has been somewhat extensive, I trust you will permit me to offer to your readers a few observations upon it.

It is perhaps as well to point out in the first place, that there is a slight error in Dr. Icery's paper, (due possibly to the conversion of French weights into English) in regard to the quantities of sulphur and lime present in a ton of the mono-sulphite of lime. The proportions of the two constituents to one another are given correctly, but the absolute weights contained in one ton are stated a little too low; the true numbers being, sulphur, 597 lbs.; lime, 1,045 lbs.

Leaving this unimportant point, I come to the decolorizing and defecating power of the mono-sulphite; and here I would ask, how can this remarkable power be accounted for, if, as Dr. Icery asserts, the mono-sulphite is insoluble in cane juice; it is known to be soluble to some extent even in distilled water, and there is reason to believe that it is even more soluble in cane juice.

A sample of Dr. Icery's sugar dissolved in distilled water, and filtered through Swedish paper, shows distinct traces of sulphite; a fact which is in direct opposition to his statement of its insolubility.

Dr. Icery himself, makes no attempt to explain the mode of operation of the salt, but its true action I take to be as follows, viz: The stronger acids of the juice decompose a portion of the sulphite, combine with its base, and set sulphurous acid free. This acid acting on the nitrogenous matter, renders it insoluble, and both are therefore subsequently removed in the scum.

This view of the case explains the importance of keeping the juice slightly acid, as any excess of lime would remove the sulphurous acid, and the nitrogenous matter would then be re-dissolved.

After the removal of these matters however, the juice should be at once neutralized, as by so doing, the crystallization is improved and a bloomy sugar obtained, which is more saleable than the grey quality sent over by Dr. Icery.

It is, I fear, impossible to obtain pure mono-sulphite of lime by means of the apparatus described by Dr. Icery; what he really obtains is a mixture of bi-sulphite, mono-sulphite, and sulphate of lime, together with a large excess of water. There is however, I believe, no difficulty in obtaining the mono-sulphite of lime in a pure state in this country. I understand it is now being manufactured in quantity and in such a condition that it will preserve its power for any length of time. If badly made, it will, as Dr. Icery states, lose its power very soon; but if properly prepared there is no earthly reason why it should not keep for a century if necessary, as long indeed as oxygen can be excluded from it.

I am, Sir,

Yours obediently,

London, Feb. 14, 1870. ALERTA.

THE CONCRETOR IN THE MANUFACTURE OF BEET SUGAR.

(From the Journal des Fabricants de Sucre.)

Rouen, (Saint Sever), Feb. 14, 1870.

Monsieur le Redacteur,

We hope to be able to inform you before long of the definite results obtained by means of the Concretor in the sugar factory at Nassandres, compared with those obtained in the usine itself. Meanwhile, we have the honour to present you with some figures which may be interesting to your readers. In order to judge of these figures impartially, it will be needful to take into consideration the conditions under which the experiments were made.

Messrs. Emile Cartier and Co., proprietors of the sugar factory of Nassandres, have been kind enough to allow us to erect contiguous to their usine a small building in which to put up a Concretor, and they agreed also to supply us with beet juice at such times, and in such quantity, as we should require it. This juice was to be gauged as to quantity, density, and temperature, in order that a comparison might be instituted at the end of the season, with the results obtained in the factory. To facilitate the manufacture, it was arranged that the juice should be supplied to us from the filters after carbonatation.

The products of the Concretor have thus been submitted to only a single filtration through spent char. We ought also to have had a room well and regularly heated, but this would have entailed more expense than was compatible with a simple experiment; we were content therefore to partition off a part of the Concretor building, in which to place our crystallizers and our tanks. This small compartment was heated by an ordinary stove, and this was also the place for our centrifugal, with its small engine. A door communicated between this room and that in which the Concretor was placed. This door was necessarily always open whilst the apparatus was at work, to permit of the passage of the crystallizers, and also during the time the centrifugal was operating, as, for want of room the mixer had been placed in the larger compartment.

Moreover, the masonry of the foundations and the building was only finished three or four days previous to the commencement of the experiment, and there were several large openings in the roof of the Concretor building for the escape of the steam, which occasioned a strong current of air; and further, on account of the limited space at our disposal, and consequently the small number of crystallizing vessels, &c., which we were able to employ, we were obliged to work the Concretor intermittently, in order not to produce more syrup than we were able to set up to crystallize; so it must be confessed that circumstances were not favourable to the apparatus.

The factory supplied us with 1,260 hectolitres of juice (27,732 gallons), of a density of 2·53 Baumé, at an average of 176° Faht.; reducing this temperature to the normal one of 60°, we have 1,241 hectolitres (27,313 gallons), of a density of 5·01 Baumé. Our yield is represented by

126 kilos. = 277 lbs. concrete.
4005 „ = 8822 lbs. 1*st Jet.*
2199 „ = 4837 lbs. 2*nd Jet.*

and 37 hectolitres (814 gals.) *Masse cuite* of 3*rd Jet*, not yet crystallized.

We subjoin table of analyses of the sugars, by M. Zalinski, of Paris.

ANALYSES BY M. ZALINSKI OF SUGARS MADE BY THE CONCRETOR AT THE USINE AT NASSANDRES.

	SEASON, 1869-70.			
	FIRST LOT.		SECOND LOT.	
	1st Jet.	2nd Jet.	1st Jet.	2nd Jet.
Crystallizable Sugar......	98·75	97·25	98·25	97·25
Uncrystallizable Sugar....	0·02	0·50	0·40	0·02
Ash	0·31	0·86	0·49	1·17
Water	0·80	0·85	0·60	0·80
Unknown	0·12	0·54	0·26	0·76
	100·00	100·00	100·00	100·00
Return at Co-efficient, 5 ..	97·18	92·45	95·40	91·35

We shall be glad to furnish any other information you may wish.

Pray accept, &c.,

W. MARTIN, FILS & CIE.

P.S.—In the usine at Nassandres the juice is diluted with a quantity of water either at the rasping or after pressing, so that 100 kil. (220 lbs.) of roots are represented in after processes by 100 litres. (22 gals.) of juice at least, and often by 120 to 130 litres. A hectolitre may therefore be estimated as produced from 100 kilos. of roots (*i.e.*, 220 lbs. of roots produce 22 gallons of juice). We shall thus have operated on 124,100 kilos. of roots (273,020 lbs., or about 122 tons) at the most. By this calculation, our yield of sugar is—

1st Jet	3·227 per cent.
2nd Jet	1·772 ,,
	4·999 or 5 per cent.

and there remain 37 hectolitres (814 gallons) of *masse cuite* of *3rd Jet.* The 126 kilos. of concrete were made at the request of Mr. Fryer, who wished to ascertain its value for the English refinery.

When the last products have been sold, we shall be able to compare the pecuniary results of the Concretor with those of the usine, and we shall not fail to communicate to you these new facts.

THE VALUE OF REPRESENTATIVE GOVERNMENT IN THE WEST INDIES.—In 1866 the following colonies still enjoyed representative assemblies, giving the inhabitants full control over the taxation:—Antigua, Montserrat, St. Kitts, Nevis, Barbadoes, and St. Vincent. In these the expenses of administering the government amounted to $2\frac{1}{8}$ per cent. on the value of the exports, and the number of children at school was 1 in 12 on the whole population. In Trinidad, on the other hand, the inhabitants have never had any share in the government, and in Dominica and the Virgin Islands the proportion of nominated members in the Legislative Council was so adjusted as to give the governors standing majorities.

In these three colonies the administrative expenses will be found to be equal to $7\frac{1}{2}$ per cent. on the value of the exports, whilst the number of children at school was only 1 in 26 to the population, thus showing that in the West Indies, as in other parts of the world, constitutional government is cheaper and more efficient than personal rule.

NEW PATENTS.—FROM THE MECHANICS' MAGAZINE.

2280. A. M. CLARK, Chancery Lane. *Manufacture of sugar.* (A communication.) Dated July 27, 1869.

The combined sugar and molasses is first brought in contact with a certain quantity of wood spirit in a mixer, where the whole is stirred for a very short time. The mixture of sugar and liquid is then passed to a filter (similar to those containing animal charcoal), from which the black liquor of molasses is run off and is afterwards replaced by pure wood spirit. A washing effected in this manner by displacement furnishes a perfectly white sugar.—Patent completed.

2302. D. STEWART, Glasgow. *Concreting sugar-cane juice.* (A communication.) Dated July 31, 1869.

The flue is made wider at the top immediately under the trays than below, which induces a more efficient action of the flame and fire gases upon the trays and dispenses with bridges. Second, the invention consists in placing a multitubular steam boiler at the end of the trays, so that the fire gases may pass onwards through it from the flue under the trays. This boiler is provided with an independent furnace to be fired for the purpose of getting up steam before the trays are in action, and such furnace is fitted with air-tight doors to be closed when the trays are in action.—Patent abandoned.

2316. W. HOSACK, Montpelier. *Sugar cane mills.* Dated August 2, 1869.

The inventor arranges the rollers in pairs, one directly above the other, this constituting the main feature of the invention, and with tables situated between the pairs of rollers, between which tables the canes pass forward. By arranging the rollers in this manner a better regulated or steadier and graduated and independently sustained pressure is produced on the cane passing through them under any variation or irregularity of feed; at the same time the quantity of juice is increased and economised. It is to be understood that any number of pairs of such rollers driven by the same power may be used in mills constructed in accordance with this invention in order to accomplish its objects completely.—Patent completed.

NOTICES OF BOOKS.

How to develope the Productive Industry in India and the East. Mills and Factories for Ginning, Spinning, and Weaving Cotton; Ink and Silk Manufactures; Bleaching, Dyeing, and Calico Printing Works; Sugar, Paper, Oil, and Oil Gas Manufactures; Iron and Timber Workshops; Corn Mills, &c. &c., with Estimates and Plans of Factories. Edited by T. R. COLA, late sole Proprietor of the Arkwright Cotton Mills, Bombay. London: Virtue & Co.

THOUGH only a few pages of this volume are in any way connected with cane culture or the manufacture of sugar, we have pleasure in noticing it, and in commending it to the attention of those who are interested in the prosperity of our great Eastern dependency.

The time is now happily past when the sole consideration with regard to the colonial possessions of Great Britain was the amount of material prosperity they might be made to contribute to the mother country; and it is a great recommendation of this book that it is "written primarily in the interest of India and the East," though, at the same time, the author believes that the development of the industrial resources of that vast empire "will not be the less to the interest of England and of English mechanics; what will benefit the one country must benefit the other also."

India is still regarded by many rather as an immense field for the production of raw material than as a manufacturing country; it is forgotten that the products of her looms, both in cotton and silks, were the wonder of Europe centuries ago. India has fallen behind simply because she has been standing still, whilst Europe has been rapidly progressing. The author of this book is of the opinion that "it is of the highest importance that the improved machinery of modern times should be substituted in place of the rude apparatus with which the arts and manufactures are still carried on in India and the East;" and with the object of furthering this desirable end, he has passed in review all the various branches of the productive industry of India, and has

given drawings, plans, and estimates of the cost of machinery which is needful for the proper development of all the manufactures, at present rudely or imperfectly conducted.

As regards the present state of the sugar industry in India, the author shows how primitive, and consequently how defective, are the present modes of native manufacture. After referring to the advances made in Europe, he observes:—

"In the mother country of the sugar cane not one step forward has been taken in its manufacture for centuries. To squeeze the juice from the canes, in several parts of India, two small wooden rollers close to each other are employed. Another form of sugar mill is on the principle of a mortar and pestle. The pestle is rubbed against the canes (cut into thin slices beforehand), a troublesome operation. The moving force is two oxen. The pressure is so imperfect that a large amount of juice is left, thus causing a loss at the very outset. The juice is boiled in pans heated over an open fire, and is made into *goor* by the poor cultivators. This *goor* is purchased by persons whose business it is to remove impurities from it, and produce sugars of various qualities, known by the names of Khur, Doloo, Gurpatta, and Doborah. . . . *Khur* sugar is made in Bengal by pouring goor into coarse gunny bags, and pressing between bamboos lashed together, until 30 to 40 per cent. of it is forced out in the shape of molasses, or sugar that will not crystallize. The residue is Khur. *Ninsphool*, or fine Khur, is made by repeating the above process, which causes a further portion to be separated. *Doolo* or *Dulloah* is made by pouring goor into open baskets, holding two or three mounds each; three inches of wet grass being placed over the goor, the molasses drain through a hole into a vessel placed underneath. As soon as the grass is dry, the upper part, deprived of the molasses by draining, is scraped off with a knife to a depth of two or three inches, and fresh grass applied. When dry, a fresh portion of sugar is scraped off, and this process is repeated till the basket of goor is emptied. The scraped-off sugar is placed on mats in the sun to dry. When well made, Doloo is dry, light, and sand-coloured. . . . . Puckha Chuna, or Gurpatta, is the refined sugar

of India. It is made by boiling Khur with potash temper, which removes the impurities. After skimming, it is filtered through a cotton cloth and boiled, then poured into earthen pots, and as it cools it forms crystals of white sugar. The syrup which drains from the pots is boiled with fresh goor, and an inferior sugar is produced called Jerannee. Gurpatta sugar is bright, clean, and dry, and keeps well. . . . . Dobarah is of superior quality to Gurpatta, being good white, dry, and well crystallized sugar, and is made from Doloo instead of Khur. It resembles the crushed refined sugar of European manufacture."

Of course the above extracts refer to the native sugar industry, not to the sugar manufactories which have been established by English capital and enterprise in Madras, Shahjehanpore, and other parts, and in which the most recent improvements in process and machinery have been applied.

Mr. Cola's book will be of considerable service; it contains many valuable statistical tables, and a considerable amount of information interesting to others besides capitalists; its illustrations and plans are well drawn and carefully executed; it is handsomely bound, and well "got up" in every respect.

Notes on the North Western Provinces of India. By a DISTRICT OFFICER. London: W. H. Allen & Co., 13, Waterloo Place, S.W., 1869.

This is an interesting volume, containing a variety of information on numerous topics; as the government, the population, the soil, the crops, irrigation, land tenures, rent rates, &c., of the district described.

The author is evidently familiar with his subject, and writes plainly and unpretendingly of what he has seen and heard. Respecting the cultivation of the sugar cane, an industry which the author thinks second only to cotton in importance to the people, there is a variety of useful information; from his account it appears that the culture is very much in advance of the manufacture.

"The ground is well prepared during the cold season by repeated ploughing, and if necessary by irrigation. In the moist countries

of the Rohilcund, and the Teraee, and in other places, for instance, in the lowlands along the Ganges, where water is near the surface and the soil is naturally damp, irrigation previous to ploughing is seldom needed; but in the Doub it is generally necessary to begin with drenching the field well with water. It is then thoroughly ploughed, and manured as much as possible, and worked until the ground is as soft and pulverized as a garden bed. In March, the cuttings of cane, about six inches long, which have been preserved from the former crops in pits, are put in by hand. From that time until the cane is cut, sometimes nearly a year after, incessant labour is required to keep the ground clean, soft, and sufficiently moist. The cane is generally ready to cut about the middle or end of November; but the time of cutting it depends greatly on the amount sown, and the amount of labour at the cultivator's command. . . . In districts where much cane is sown, the mills are four months or even longer in work; day and night in some places. Some of the crop will therefore be left standing until February; and it must be carefully tended, and watered if necessary, to prevent it from being dried up.

"Sugar cane ought to be sown in land which has been fallow during the previous year. But even the best cultivators, if they can get manure and water, will take a crop of maize, and sometimes even of cotton off the land which is to be planted with cane in March.

"Sugar cane cultivation is seen in perfection in the Meerut district, under the industry and skill of the Jâts, a tribe famous as agriculturists. The fields there resemble groves of small palm trees the cane is so tall. Every four or five canes are tied together to keep them from bending or hanging over, and the interstices are kept beautifully clean and regular. In Rohilcund, where the cane requires less care and labour, I have never seen it in such perfection."

The profit yielded by this careful method of culture appears to be ridiculously small, as, according to our author, an acre of standing cane may be bought for about six pounds sterling; the rent being 30 shillings per acre, the whole remuneration for the labour

of the cultivator and the keep of his cattle, is only £4 10s.; it is rare, however, that the cultivator does sell his cane. As regards the profit when the cultivator is also the manufacturer, the author informs us that it is difficult to form a true estimate. A native grower told him that the produce of the sixth of an acre would sell for about fourteen rupees, or eight pounds ten shillings per acre. Regarding the cane mill peculiar to the district, he differs from Mr. Cola in his estimate of its utility. We read:—

"The mill in common use in the north west provinces for crushing the cane is of the rudest kind. It consists of a large trunk of a tree, which is buried about six feet in the ground, and rises about three feet above it. This is hollowed out, so as to form a mortar; and at the bottom of the mortar a hole is drilled, through which the juice of the cane can run into a vessel placed on one side to receive it. A long upright beam is placed as a pestle in the hollow trunk. To the lower end of the pestle, and at such a height above the mortar as to allow it to work freely, is attached a boom of wood, to which the bullocks are yoked, and by which the pestle is turned. The centre of this boom is joined to the top of the pestle by another spar of wood. The pestle and the two spars thus form a triangle, one side, viz., the pestle, descending into the mortar, and the base being extended so as to form a yoke for the bullocks, on whose necks it is supported. When the bullocks are yoked, the driver seats himself on the boom, between the bullocks and the mill, and thus adds his weight to the pressure of the pestle. He then drives his cattle round and round, while another man feeds his mill with bits of cane about five or six inches long.

"This mill, though primitive, is very effective; and the cane is thoroughly crushed, and leaves it as dry as tinder. A modern mill was, I believe, once started in Rohilcund, and worked for some time. But the cane, after passing through it, was gathered by the natives, and put through one of their own mills with profit!"

It is rather difficult to understand this statement; it may be, and probably is, literally correct, but as it stands it is likely to mislead; the author should have been at the pains to have ascertained the kind of mill the failure of which he records, and also

the attendant circumstances. He tells us, certainly, that the native method takes a long time, but that time is comparatively of little value in India; but where the sugar making season extends through four months night and day, the time occupied in the crushing of the cane must be of no small value, especially where the standing cane has to be "carefully tended and watered to prevent it from being dried up."

It seems that the consumption of sugar by the native population is very large, and that refined sugar is about the same price as in England, although there is no excise duty.

Considering its apparently profitable character, it is strange that the sugar manufacture in India has not attracted British enterprise and capital to a greater extent. Probably the nature of the ownership and tenure of the soil has operated against this. It would be impossible for an individual or a company to get possession of land to any extent, fit for the growth of the cane, at least in any part where man can exist. In the words of our author, "It is not a case of Canada or Australia; you cannot go into the country and measure off a few thousand acres where it pleases you, and take possession. On the contrary, you will go into an ancient and thickly populated country, among a litigious, ill-disposed people:" with a population of this character, there would be considerable difficulty in introducing the central factory system, even were other things favourable.

THE SOURCES OF THE SUPPLY OF SUGAR TO THE UNITED STATES DURING 1869.—The chief source of the supply of sugars to the United States has been Cuba. Notwithstanding the disturbances there, it is estimated that this island has sent to the States 80 per cent. of their consumption, an increase of from 5 to 7 per cent over 1868. Brazil has furnished over 6,000 tons; twice as much as in the year preceding. Imports from Manilla and other eastern sources have also been doubled, and from the French colonies, quadrupled. The (expected) diminution of the production of Cuba, and the probability that the diminution will continue for several years, has given a fresh impetus to planting in Louisiana. Great efforts have also been made to extend cane culture in the south of Texas, and to introduce it into Florida.

Estimate of the present season's Beet Root Sugar Crop in Europe, compared with that of 1868-9, in Thousands of Tons.

	1869-70	1868-9.
France	260	203
Zollverein	207	208
Austria	98	76
Russia	100	65
Belgium	40	37
Poland and Sweden	33	23
Holland	12	10
	750	622

Stocks of Raw Sugar in the Chief Markets of the World, in thousands of tons, to December 31st.

	1869.	1868.
United Kingdom	119	172
France	129	148
Holland	21	34
Zollverein	42	62
United States	81	44
Cuba	16	7
Total	409	466

Consumption in Europe and the United States, in thousands of tons, for the year ending 31st December.

	1869.	1868.
Europe	1304	1171
United States	429	424
	1733	1595

SUGAR STATISTICS—GREAT BRITAIN.

To 19th Feb., 1870 and 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	7	1	1	..	9	19	4	1	1	3	8	11	7	1	1	2	10	25
British East India	13	3	..	..	16	12	2	..	..	..	2	5	3	1	..	..	4	2
Mauritius	4	..	2	1	7	8	3	..	3	1	7	6	1	..	3	1	5	5
Cuba	9	2	1	4	15	11	..	2	2	5	10	7	1	4	2	7	15	16
Porto Rico, &c. ..	2	1	..	1	3	3	..	..	..	..	1	1	1	1	..	1	3	2
Manilla, &c.	34	7	..	1	42	48	3	2	1	..	6	8	5	2	..	1	8	5
Brazil	..	6	1	2	10	21	..	4	1	2	7	10	..	6	1	2	8	11
Beetroot, &c.	2	1	..	2	5	5	6	2	1	6	15	9	6	2	1	8	17	7
Total, 1870 ..	71	19	6	11	107	127	19	11	9	17	56	57	24	17	8	22	71	73
Total, 1869 ..	73	32	6	15	20 decrease		25	11	9	12	1 decrease		28	16	6	23	2 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

Two causes have combined to depress the market during the last month, viz: The large quantity of beet root sugar on offer from France and Germany, and the uncertainty as to the course which will be taken by the Chancellor of the Exchequer respecting the duties, on which account, both refiners and grocers are anxious to reduce their stocks to the lowest possible point. Notwithstanding the heaviness, prices have only given way to a very trifling extent, and there has been no alteration to note in the value of refined sugars.

The stocks in the United Kingdom show a rather less relative decrease than last month; imports up to the present time, since the end of the year, are about the same as during the same period in 1869; whilst deliveries, for the reason above stated, are over 2,000 tons less. Stocks in France, on the 31st of last December, were 20,000 tons less than at the same date in 1868, notwithstanding the large increase in the beet sugar production of that country.

Should there be any material reduction in our sugar duties, there is no doubt that increased consumption will favourably affect the prices which planters will receive for their produce; and it may be noted, that there is a probability of a reduction of the duties in the United States, which will further stimulate the already rapidly increasing consumption of that country. On the other hand, the effect on the market of the large excess of beet-root sugars must not be lost sight of. With regard to this source of supply, the *Journal des Fabricants* says, "our European manufacturers should rather moderate their future production than develope it to any further extent."

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☞ The writers alone are responsible for their statements.

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PRACTICAL OBSERVATIONS ON CANE MANURE.—No. II.

By Dr. T. L. Phipson, F.C.S., London.

Member of the Chemical Society of Paris.

Among the soils from the West Indies, the compositions of which have been examined in my laboratory within the last few years, I will refer especially to the two following, one of which is from an estate in Jamaica, and the other from Demerara. They present the following compositions:—

Soils.

	Jamaica.	*Demerara.*
Moisture	12·25	18·72
Organic matter and combined water	15·36	6·03
Silica and insoluble residue	48·45	68·89
Alumina	13·80	2·50
Oxide of iron	6·72	2·60
Lime	0·99	0·08
Magnesia	0·29	0·25
Potash	0·11	0·10
Soda	0·70	0·09
Phosphoric acid	0·10	0·03
Sulphuric acid	0·30	0·03
Chlorine	0·51	trace
Oxide of manganese, carbonic acid, and loss	0·42	0·68
	100·00	100·00
Nitrogen	0·31	0·05

The Jamaica specimen may, from its composition, be fairly considered as a tolerably fertile soil, provided there is no mechanical obstacle to be overcome; but it presents a peculiarity which is rather remarkable: there is, as seen by this analysis, at least one *per cent.* of chloride of sodium in the soil, and many agriculturists would suppose that so large a quantity of salt might be prejudicial not only to the cane, but to almost any other cultivated plant. I am not of this opinion; for, in the first place, the soil itself, a stiff clay like all good cane soils, reminds me of that of the *Polders*, along the Flemish coast, where some of the finest wheat in the world is grown, and where the soil is slightly salt (especially the sub-soil) from proximity of the sea;* and, in the next, from the fact that salt springs abound over the whole island of Jamaica, and, nevertheless, cane culture has been carried on there for a long period of time with the greatest success.

Another peculiarity in this soil is the large amount of nitrogen, which adds considerably to its fertile quality.

In the case of the second sample, from a large estate in Demerara, my report was to prove whether the soil or the management was the cause of the falling off of the crops. There can now be no longer any doubt upon this point. It presents a very different composition from the Jamaica soil. I choose these two analyses from among a certain number, as furnishing the best examples which I can at present supply of two opposite qualities of West Indian soils. Both are clay soils, and both appear to be perfectly adapted *mechanically* for the growth of cane; but the second contains a considerable amount of sand, and much less matter soluble in hydrochloric acid; and whereas the first will yield good crops for many years without much manuring, the second is so far gone that large quantities of that somewhat dangerous stimulant, sulphate of ammonia, were (until lately) being annually applied, to enable the

* As I have before stated in my prize essay, "On the Agricultural Uses of Salt, &c.," printed by the Chamber of Commerce of Northwich in 1863, where I have very carefully recorded all that is known with certainty as regards salt in connection with the health of animals and plants.

plant to take up the last available atoms of phosphorus, sulphur, potash, and lime, requisite for its perfect development and full yield of sugar.

On the other hand, let us take a glance at the composition of the ash of the sugar cane. Here are two analyses, chosen from a certain number, made by my esteemed friend, Dr. Stenhouse, to whom organic chemistry owes some of the most interesting discoveries that have been realized in modern times:—

Cane Ash.

	Jamaica.	*Demerara.*
Silica	54·22	17·04
Lime	14·27	2·26
Magnesia	5·27	3·80
Potash	11·59	39·51
Soda	2·08	8·24
Phosphoric acid	7·96	7·12
Sulphuric acid	1·91	7·70
Chlorine	2·70	14·33
	100·00	100·00

The comparatively small amount of lime and silica in the Demerara sample appears owing to the fact that the ashes of the stalk *without the leaves* were submitted to analysis; hence also, I believe, the predominance of chlorine and soda in this analysis compared to the other.

The largest figures in the above analyses are those of *silica, lime, potash*, and *phosphoric acid*, especially if we consider the Jamaica sample, *i.e.*, the ashes of the *entire plant*. But the inspection of the mean result of a large number of analyses of cane ash shows that *sulphuric acid* and *magnesia* appear to have their importance also, whilst *chlorine* and *soda* are represented by comparatively small figures, but are still present in the ash as chloride of potassium, 4 *per cent.*, and chloride of sodium, 5 *per cent.*, or thereabouts.

We know, however, that the composition of the ash of any plant

varies *very considerably* with the period of the year at which the plant is cut and the parts of the plant burnt for analysis; so that it is by no means an easy task, at first, to state with accuracy what substances a plant takes in largest quantities from the soil. With regard to the sugar cane, it appears, nevertheless, to be pretty well proved that the principal substances required in the soil are *nitrogen*, *potash*, *silica* (soluble), *phosphoric acid*, *sulphuric acid*, *lime*, and *magnesia*. We may state at once that *oxide of iron* and *oxide of manganese* are, perhaps, also essential; for, in a long series of interesting experiments made in 1849 by the Duke of Salm-Hortsmar, a chemist of much experience, the conclusion was drawn that a graminaceous plant (the oat) absolutely required for its complete development the eight mineral substances we have just enumerated.*

The composition of the fully developed sugar cane may be represented as:—

Sugar Cane.

Water	71·04
Sugar	18·02
Cellulose	9·56
Albumine	0·55
Fatty and colouring matters	0·35
Salts soluble in water	0·12
,, insoluble ,,	0·16
Silica	0·20
	100·00

Want of leisure obliges me to postpone until next month what I have still to say on this subject.

Analytical Laboratory, Putney, London, S.W.,
March 18th, 1870.

* With nitrogen, then, it appears that nine substances at least are absolutely necessary to the development of sugar cane, and probably no cultivated plant can attain to perfection with less.

NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

By William Arnot, F.C.S.

(*From the Chemical News.*)

V. Precautions to be Observed in Estimating the Relative Decolorative Power of Chars.

Simple as the process of testing the relative decolorative power of char samples may appear, very perplexing results are not unfrequently obtained. The object to be aimed at is to make the circumstances which obtain, as nearly as possible, the same on the small scale as on the large, and it is because many little precautionary measures which tend towards the attainment of that equality are usually omitted in the laboratory that such conflicting and apparently inexplicable results are recorded. After many modifications of the process, the author is satisfied, from the results of experiments extending over a considerable period, that if the following points are carefully attended to, the results may be relied upon :—

1. It must be decided what the results are to express; whether the relative decolorative power of *equal bulks* or *equal weights* of the chars, *irrespective of size and proportion of grain*, of the chars, *uniformly freed from dust*, say by a fifty-mesh sieve, or of *equal weights* of *equal grains*.

2. According as either of these alternatives is decided upon, the various samples must be thoroughly and intimately mixed, and, if necessary, brought to an uniform dryness and temperature. It is always safest to have them thoroughly dry, and at the temperature of the surrounding air.

3. The various samples are next to be filled into glass tubes (tin may be used, but they preclude observations of a very important kind) provided with perforated false bottoms, covered with layers of cloth, and with taps capable of being accurately regulated. The tubes ought to be about 2 inches wide and 2 feet long, as nearly of the same diameter as possible. The best method of filling them is

by passing the char through a funnel, keeping the spout of the funnel moving constantly in a circular direction, so as to have the large and small grains equally diffused throughout. To allow the char to run down either at one side, or, to a less degree, in the middle, is to cause to a certainty a separation of the larger grains from the smaller, and thus to create channels through which the liquor has too easy access.

4. See that no tube is touched or shaken more than the others, after the char has been filled in.

5. Sufficient brown sugar liquor, of, say 24° B, must be prepared, either by diluting raw filtered liquor from the sugar-house to that gravity, or by dissolving as much of an average quality of raw material as will make sufficient liquor for the whole experiment. In the case of preparing it on the small scale, albumen or blood must be liberally used, and the liquor passed through paper filters: coarse French paper answers best. The albumen should not be added till all the sugar has been dissolved, and the temperature at, say 160° F. An equal quantity of the prepared liquor, as nearly 180° F. as possible, must now be poured uniformly upon the char in each tube.

The rapidity with which the liquor passes through the chars in each case may be noted. Care must be taken to have the top of the char always covered with liquor, and the taps below open. As soon as the liquor begins to drop at the taps they are closed.

5. The tubes being fully charged with liquor (there should be as much left on the top of the char as will serve to force out the liquor in the char), they are put into a cistern of water at 140° F., the water in which will rise to about 1 inch from the mouths of the tubes, the time is noted, and the cisterns, which ought to be felted, covered.

6. At the end of not less than one hour (longer than one hour is sometimes advantageous, particularly if the raw liquor was very brown), the tubes are withdrawn, placed in their stand, and about 2 ounces of liquor run off each; this may be rejected, as the portion between the false bottom and tap is often turbid, and in addition has not been in contact with the char, for a sufficient

length of time. The remainder of the liquor, *i.e.*, so much as has actually been in contact with the char, may now be run off in three successive quantities for comparison. The results may be compared to any set of standard colours, and recorded accordingly.

7. If these results are not sufficiently instructive, a further quantity of raw liquor may be run on each tube, and the whole transferred as before to the water-bath, which, if felted, will still be hot enough. The second quantity of liquor will be run off with the same precautions as the first, and the results will show the *relative persistency* of the chars under trial.

If the taps are large, the liquor will be likely to run off too rapidly, and in that case they had better be partially and uniformly closed.

If it is found that the liquor runs through one sample particularly slowly, and through another particularly fast, it is quite admissible to assist the one by suction, and to check the other by closing the taps; but this should not be done unless in extreme cases, and the fact of having so assisted or retarded the process should always be noted.

It is scarcely necessary to mention the several points wherein the foregoing differs from the course usually pursued in testing chars, and yet it may be useful briefly to indicate some of these.

Too little care is usually bestowed upon the selection and preparation of the samples. The tubes used are, as a rule, too small: the char cannot be run so uniformly into small tubes as large ones. The samples once charged with liquor are not usually kept warm: it is essential that they should. Some chars act powerfully at low temperatures, while others require a considerable amount of heat to bring out their maximum decolorative power; care must, however, be taken that the temperature employed does not exceed that attained on the large scale in the refining process. The fact just noted does not seem to have been much investigated; it is worthy of careful consideration, not only on the part of experimentalists, but also by the practical refiner. One sample of char, known to be of very inferior decolorative power on the working scale, persistently gave results, by the usual method of testing in the labora-

tory, equal to the very finest chars obtainable, but when kept at an elevated temperature along with the finer samples, in the manner indicated above, its inferiority was at once manifest. The facts in this case were that the inferior char readily yielded, all its decolorative power at the low temperature, while the finer samples required the influence of heat to call their whole power into action.

VI. The Constituents of Char, Important and Unimportant.

In the absence of a knowledge of the refining process, and the circumstances attendant on the use and revivification of animal charcoal, much time may be unprofitably spent over an analysis of that agent. While it is always desirable to have analyses carefully and accurately executed, the analyst should be able to discriminate between the essential and non-essential elements or compounds in the substance before him, and, while he aims at general accuracy, more than usual care should be bestowed upon substances the presence or absence of which mark the value of the agent under examination.

The points of greatest importance in an analysis of animal charcoal are the carbon, the carbonates, and the iron; the decoloriser, the neutraliser, and the destroyer. Under certain circumstances the sulphates may also be included in the list, and in the case of new unused char the alkaline salts should be carefully estimated. These essential points carefully ascertained, no modification of them should be thought of, whatever the phosphates may come out. If the analysis should come to 105, ten to one but the phosphates are to blame, and not the carbon and carbonates. The phosphates are comparatively unimportant, and when it is remembered how various are the methods employed, and how faulty some of them are, errors under that head need not be greatly wondered at. There is no excuse whatever for error in the carbon, the process is simplicity itself; the carbonates can be quickly and accurately estimated by the calcimeter (Note I.), while the iron, after some little practice, can be safely got at by Penny's process, using a very dilute solution of dichromate. The iron is always in the state of protoxide, faint traces of peroxide excepted, owing to

the reducing action of the carbon in the re-burning. Of course, these remarks are intended to apply exclusively to commercial samples for use in the refinery. When char is to be sold for the manufacture of manure the circumstances are altered, and the phosphates become the essential element in the analysis.

VII. M. Gaston Tissandier's Method of Analysing Animal Black.

When the author of these notes penned that immediately preceding this, he little thought that it was at all necessary to go into the details of the process of analysis, but contented himself by simply throwing out a hint or two upon the subject; the simultaneous appearance of M. G. Tissandier's notes upon animal black with his own has, however, shown him his mistake. The methods recommended by that gentleman are so faulty as to demand some special remark.

1. The Carbon.—M. G. Tissandier arrives at the proportion of this most important agent by a method which cannot be relied upon. The writer at one time thought that he had made a great time-saving discovery, when the idea of doing as M. G. Tissandier recommends, struck him; but he soon found out his mistake. The difference between the "ash" and the original weight *does not* give the carbon and moisture. To whatever cause it may be due, the results obtained by this process always differ from those obtained by the more trustworthy method hereafter to be described. Two objections to M. G. Tissandier's process may be pointed out. There is always iron present in animal black, and, as indicated in the preceding note, it always exists as protoxide; this is, of course, peroxidised by M. G. Tissandier's process. The carbonates are liable to decomposition, and though caution, during the process of calcination, is recommended, the manipulator has no guarantee that he has not decomposed a portion of them; and to moisten with ammonic carbonate, as recommended by Dr. Wallace, is not at all safe. The analysis should always be made upon the dried sample; the moisture may, of course, be estimated in the usual way, in a portion (several hundred grains) of the original *unground* sample; but, with working chars, unless the sample is

for sale, the moisture may be left out altogether. It may be necessary to state, as a reason for estimating the moisture in the original char in preference to the pulverised, that in the process of grinding, which occupies some time, the char, if comparatively dry, is liable to absorb moisture from the atmosphere. 50 grs. of the sample, in impalpable powder (which *should not* be sifted, but the whole reduced uniformly to the necessary fineness, the hard gritty grains which so persistently resist the action of the mortar and pestle sometimes, have usually a different composition from the softer portions, and ought not to be rejected, as M. G. Tissandier recommends), are boiled in dilute hydric chloride; twenty minutes are usually necessary to accomplish this satisfactorily. The insoluble is thrown upon a weighed filter, and very thoroughly washed; the filter, after drying, is weighed—the difference being carbon and sand. The drying and weighing must be very carefully attended to; after the first weighing, the filter should be returned to the drying oven, and after a time weighed again, and so on until the results are constant. The filter is then ignited, the residue being sand and clay; the weight of this, deducted from the previous result, will, of course, give the carbon, and that accurately. The carbon being a most, if not the most, important element in the char, its accurate determination must be made a point in the analysis.

2. THE SILICA by M. G. Tissandier's process will be found much too high; "water acidulated with chlorhydric acid," "slightly heated," will scarcely have the desired effect upon ignited "ash." The twenty minutes' boiling with moderately strong acid, referred to above, will be no more than competent to do the work indicated, but from the preceding remarks it will be seen that the sand, &c., can be got at otherwise.

3. THE PHOSPHATES.—It seems passing strange that the system of precipitation by ammonia should again require to be publicly protested against. The results by this process are worth nothing; and how, otherwise than by accident, an analysis can be got to come to 100 when it has been employed the writer cannot guess. Perhaps if M. G. Tissandier had been asked to reconcile the phos-

phate results of different analysts (as the writer has been), he would long ere this have consigned the process to oblivion. Better leave the phosphates alone altogether than precipitate them by ammonia; the analysis will more likely be correct. Precipitation as ammonio-magnesian phosphate will, with care, give reasonably accurate results.

4. The Carbonates must not depend upon the lime left over in the solution after the separation of the phosphates: many errors creep in here. The total lime should be estimated by precipitating with oxalate of ammonia, as a check upon the other results; but the carbonic acid itself must be the guide to the amount of carbonates. One process for carbonic acid has already been referred to with favour. In the absence of Dr. Schiebler's apparatus, however, some of the usual gravimetric methods admitting of the use of hydric chloride may be employed.

5. M. G. Tissandier makes no mention of iron in his analysis. He may be dealing all alone with new, unused char, in which the iron is usually very trifling; but he does not say so. The iron is an essential point in the analysis of used chars, and is not to be passed lightly over even in new, unused chars. As already indicated, its estimation may be accurately made by Penny's process. The strength of the dichromate solution best adapted for the delicate operation is 2·75 grs. of the pure and dry salt to 1000 grs. of water; in which case the alkalimetric measures consumed will be divided by 16 to give percentage of metallic iron, *i.e.*, supposing 100 grs. of the char to have been used. The process must be conducted neatly and rapidly, as the solution is liable to absorb oxygen from the atmosphere.

M. G. Tissandier concludes this part of his paper by appending the results of the analysis of three samples of char. The writer has seen and executed several hundred analyses of this agent, and never, in all his experience, has he met with more extraordinary results than those given by M. G. Tissandier, as illustrative of the composition of this substance (?). Are these the analyses of new chars, or old? Have they been used in the "beet" manufacture, or in connection with some special process? Where is the iron

and the sulphates? For what object are the results published? Without some information upon these points, they can only mislead the reader.

M. G. Tissandier's method of estimating the decolorative power of chars is very pretty, but of no practical value. The results will express *the relative power of pulverised animal black to decolorize caramel;* but that is not what the sugar refiner requires. For sugar refining purposes, nothing but sugar refining methods of testing decolorative powers will do. The author has tried many devices, both with grain and pulverised char, with logwood decoction, caramel, &c.; but the results in no case give the true value of the char to the refiner. The directions given in Note V. have been followed, with the most satisfactory results, for three years. During that time, several other *simpler* systems have been tried; but all have had to give way to the *more tedious, but accurate,* system described.

RESEARCHES ON THE SACCHARINE RICHNESS AND YIELD OF DIFFERENT VARIETIES OF SUGAR CANE IN JAVA.

By M. J. A. Krajenbrink.

(*From the "Journal de l'Agriculture des Pays Chauds."*)

I recently proposed to the Natural Science Society of Batavia to establish a plantation for the trial of varieties of sugar cane in Java, with the aim or object of completing the results which I obtained myself in 1858 and '59, in the comparative cultivation of the varieties common to Teloek-Djambie, in order to choose the most suitable for the manufacture of sugar. Unfortunately, these experiments were made on too small a scale, and under circumstances of too special a nature to be applicable by the generality of planters. Thus I have thought it my duty to recommence my own experiments on a larger scale, and to endeavour to remove every cause of erroneous appreciation.

I am now about to make known the numerous results of my re-

searches, which may serve to guide others in their choice of varieties until more extensive experiments, on which it is to be hoped that great numbers will enter, may be made.

The results at which I have arrived, and which I am now about to detail, may perhaps be of immediate practical interest to the sugar planters of the east of Java, and especially of Krawang, where those who carry on this industry are obliged to rely on their own experience.

In the determination of the yield and of the comparative richness of the cane, I have followed the same course which I pointed out in my *mémoire* on the results of the action of manures on the composition of the cane.

The experimental plantation was made on a piece of land entirely composed of brown red clay, very rich in oxyde of iron, which is met with everywhere in Java in the form of a bed of compact diluvium, furrowed by water courses, and upheaved by recent subterranean commotions, which render its recognition more difficult, and the formation of which is still an enigma. This soil possesses all the physical conditions necessary to fertility, but it loses its humus quickly, and then becomes sterile, and when, during the eastern monsoon, the drought is long continued, the crops suffer much. It follows that the only favourable time for planting is just before the western monsoon; in the interval between the two monsoons the plants have time to become deeply rooted in the earth.

At the season when this experiment was made the western monsoon occurred late, and consequently the rains which continued until the commencement of the eastern were favourable to the development of the canes, and gave more time to execute the necessary work of preparing the soil. There is no other circumstance connected with this experiment which throws any doubt on the result.

The canes were planted in rows about five feet apart, three rows of each variety of cane, each row 86 yards in length. The plants were placed near together, and were all uniformly treated with farmyard manure, a basket to each metre in length in each row,

(about 30 cart loads to the acre), which was earthed in by hand labour. The plantations were made in the usual manner. Every needful care was taken of the canes during their growth, and after the second hoeing they were manured with a small quantity to each of ground oil cake. They were cut in September, after a period of dry weather which had hastened the ripening of the canes.

All the calculations, the weighing, and the measuring were done by myself, to avoid the errors which arise when such things are left to subordinates; and I am responsible for the exactitude of my figures, as indicated in the following tables:—

Table A.

Experiment Made in 1860, at Teloek-Djambie, on Different Varieties of Sugar Cane.

Results of the culture of about 450 square yards of each kind.

Names of the Varieties of Canes.	Number of the Canes obtained.	Quantity of Juice extracted.	Average of Juice from each Cane.	Number of Canes to the Acre.	Quantity of Juice to the Acre.
		GALS.	GALS.		GALS.
1. Red Cane of Batavia	2,140	397	0·185	51,300	9,535
2. Itam, or Monjet de Cheribon..	1,710	226	0·132	41,000	5,417
3. White Cane ..	1,800	269	0·15	43,200	6,452
4. Assep, or Woe-long	2,030	257	0·126	48,700	6,144
5. Njamplong de Sourabaija ..	2,230	171	0·077	53,500	4,096
6. Soerat	1,820	217	0·119	43,600	5,197
7. Otaheite	1,260	214	0·17	30,200	5,131
8. Awoe de Paso-eroean......	2,180	312	0·143	52,300	7,488
9. Awoe de Teloek Djambie....	2,220	336	0·151	53,300	8,061

* The juice was expressed by a mill on Robinson's system, which gives 65 to 70 per cent. of juice. The quantity of juice thus obtained was accurately measured.

TABLE B.—RESULTS OF THE EXAMINATION OF THE JUICE* OBTAINED FROM DIFFERENT VARIETIES OF CANE.

Varieties of Cane.	Proportion of Sugar Determined by the Areometer.				Proportion of Sugar Determined by Observation. *Uncrystallizable Sugar.*			*Crystallizable Sugar.*		Total Quantity of Sugar per Gallon of Juice.
	Baumé.	Specific Gravity deduced.	Weight per cent. of Sugar.	Weight of Sugar per Gallon of Juice.	Volume of Juice Operated on.*	Containing Sugar in Grammes.	Whence Sugar per Gallon of Juice.	Degrees of Polarization.†	Weight of Sugar in Gallon of Juice.	
				lbs.	c.c.		lbs.		lbs.	lbs.
1. Red Cane of Batavia	8·6	1·064	15·5	1·65	15·5	·05	·320	80°1	1·32	1·64
2. Itam, or Monjet	10·7	1·081	19·32	2·08	36·5	·05	·187	112°0	1·84	1·98
3. White, or T. Pring	10·7	1·081	19·32	2·08	40·0	·05	·125	114°1	1·87	1·998
4. Assep, or Woe-long	10·8	1·081	19·51	2·11	50·0	·05	·100	120°3	1·98	2·08
5. Njamplong ..	11·3	1·086	20·41	2·21	26·0	·05	·192	115°9	1·91	2·10
6. Socrat	11·	1·083	19·87	2·15	59·0	·06	·102	110°7	1·82	1·93
7. Otaheite	10·2	1·076	18·41	1·98	29·0	·05	·172	96°1	1·58	1·76
8. Awoe de Pas-socroean	8·2	1·061	14·76	1·56	24·0	·05	·208	73°7	1·21	1·42
9. Awoe de Teloek Djambie	8·5	1·063	15·32	1·62	22·0	·05	·227	75°4	1·24	1·47

* The liquid *observed* was prepared in the following proportions:—Cane juice, 10 cub. centimeters and water 90 c. cent.

† In deducing these figures account was taken (1) of the degrees of the saccharometer; (2) of the correction rendered necessary by the presence of a solution of subacetate of lead; (3) of the correction resulting from the difference in the rotation produced by the presence of levulose in the juice.

The table A. shows the agricultural results of the experiment, that is to say, the number of canes obtained, the quantity of juice they yielded, and, for comparison, a calculation of the quantities of each per acre. In table B. are the results of the examination of the juices obtained from the different species of canes with regard to their saccharine richness.

The aim of the cane sugar industry being to obtain the largest quantity of sugar, we may see that, using mathematical formulæ, we obtain the result by these three factors. (1) The yield in weight of canes for a given surface; (2) the proportionate quantity of juice extracted from the canes; (3) the quantity of crystallizable sugar contained in the juice. If we represent them by the three letters, X, Y, Z, the product may be calculated by the formula, $P = X \times Y \times Z$. It follows that the product will be highest when these three factors attain their greatest value. But it will be necessary to remark that P may descend to its minimum expression if one of the factors only is very small, whilst it may reach its highest if two of them even are low, if the third is very considerable. The following table, calculated from the other two, will show this relation :—

Varieties of Cane.	X Yield in No. of Canes per Acre.	Y Average of Juice per Cane.	Z Crystallizable Sugar per Gallon of Juice.	P Product in Crystallizable Sugar per Acre.
		galls.	lbs.	lbs.
1. Red Cane of Batavia ..	20,800	·185	1·32	5,079
2. Itam de Cheribon	16,600	·132	1·84	4,032
3. White, or T. Pring....	17,400	·150	1·87	4,880
4. Assep, or Woelong	19,700	·127	1·98	4,954
5. Njamplong	21,400	·077	1·91	3,147
6. Soerat	17,600	·119	1·82	3,812
7. Otaheite	12,200	·170	1·58	3,277
8. Awve de Passoerven ..	21,100	·143	1·21	3,651
9. Awve de Tolock-Djambie	21,500	·151	1·24	4,026

If it were necessary to consider on the above figures alone, it

would be easy to decide which of the nine varieties of cane experimented on should have the preference; but in practice it is needful to take other things into consideration, or you run great risk of being deceived. Private planters in Java are obliged by the organization of their industry, of which the terms differ much from those of the factories and enterprises of the Government, to have two-thirds of their crops in ratoons, and their culture is thus carried on, one-third in plant canes, one-third 1st ratoons, and one-third 2nd ratoons. Now experience has shown that some varieties of cane ratoon better than others, and that those which have a tendency to flower are easily damaged by bad weather, whilst others will ratoon without any risk of this, and thus give an average satisfactory yield. This is the case with the Batavian cane, No. 1, and the two varieties of Awoe, Nos. 8 and 9, all three of which flower seldom, and only exceptionally even as ratoons.

Thus, then, in order to be able to pronounce decidedly in favour of any particular variety of cane, the experiment should be carried on to the 1st and, if possible, to the 2nd ratoons. It is only after ascertaining the sum of the products obtained during three years consecutively from the same plantation that we are able to appreciate the comparative value of the different varieties of cane experimented on at the same time.

Considering the interest attaching to these investigations, it is to be hoped that the planters of Java will not be long before they possess sufficient data on all these points for practical application.

Another question now presents itself, the consideration of which we shall do well not to overlook, because it is one of great influence on the economy of the sugar manufacture: I mean the quantity, more or less, of water which it is necessary to evaporate from the juice of different sorts of cane. It is certain, after the indications furnished by the preceding tables, that each kilogramme of sugar obtained in the experiments with the varieties of cane corresponds to an unequal weight of water. We can understand the interest

attaching to this, inasmuch as thereon depends the expense of fuel needful for the evaporation. This is a primary consideration in localities where fuel is dear and difficult to obtain, or where it is likely to become scarce, as in some parts of the east of Java. It will be worth while, then, to put, in form of the following table, the data for judging of the treatment of the canes with respect to the water to be evaporated.

Again, we may inquire, when seeking to establish the comparative value of different varieties of sugar cane in similar conditions of culture, by what means, based on the principles of rational agriculture, it is possible to increase the value of one or more of the factors which we have represented by the letters, X, Y, Z, and which constitute the relative value of the cane, without, at the same time, sensibly diminishing the others. In other terms:—

1st. Can we increase the richness of the cane juice represented by the proportion of crystallizable sugar contained in one gallon, without at the same time diminishing the proportionate quantity of juice yielded?

2nd. Can we obtain finer and stronger canes without diminishing the quantity of the juice or its saccharine richness?

3rd. Can we obtain a larger number of canes [to each stool] without injury to their development, and without injuring their richness in juice or sugar?

The answers to these questions will be found in the judicious use of different manures, and must be the object of a different kind of experiment to the present. It is needful, in the first place, to determine which cane is the best, by its natural and specific qualities, for future experiment with different manures.

After these general considerations, we will examine the specialities of each description of cane cultivated, and sum up the numerical results obtained.

Species of Cane.	Degree Baumé.	Gallons of Water in 100 Gallons of Juice.	Juice obtained.	Water to be Evaporated.	Crystallizable Sugar contained.	Weight of Water to be Evaporated for each lb. of Sugar.	Weight of Water to be Evaporated for the produce of an Acre.
			galls.	galls.	lbs.	lbs.	lbs.
1. Red Cane of Batavia ..	8°6	89·85	397	356	524	6·80	34,600
2. Itam	10°7	87·15	226	197	416	4·74	19,200
3. White Cane	10°7	87·15	269	234	504	4·64	22,700
4. Assep	10°8	87·02	257	224	508	4·41	21,800
5. Njamplong	11°3	86·36	171	148	326	4·53	14,400
6. Soerat	11°	86·76	217	188	396	4·75	18,300
7. Otaheite	10°2	87·80	214	187	337	5·57	18,200
8. Awoe Passoeroen	8°2	90·36	312	282	378	7·46	27,400
9. Awoe Teloek-Djambie ..	8°5	89·99	336	302	418	7·23	29,400

1st. The red cane of Batavia is very uniform in its constitution and properties. It is not prone to flowering, and of all the varieties I have examined, it is the one which yields the largest proportion of juice; but this is also of the weakest density, except one of the Awoes. The density given, 8·6 Baumé, may be considered as above the average, and was owing to free manuring, the full maturity of the canes, and the favourable weather. The juice of this cane rarely attains this density here. In the eastern parts of the environs of Batavia, where the soil is lighter and more sandy, it gives richer juice, marking 9°B. on the average. It ratoons well, and will stand the drought; but it does not grow high in marshy ground or with clayey sub-soil. In the clayey soils, it is best planted at the beginning of the year, during the last rains, when the waters easily run away. It will stand 16 or 17 months without damage.

The disadvantage of the red cane of Batavia is that it presents a deceitful appearance at crop time, especially when it has been planted at the commencement of the western monsoon. It often happens that this cane develops top shoots, which attain a diameter of about two inches, and of which the luxuriant vegetation gives promise of a fruitful crop. Thus it is not uncommon to see these canes prized by the directors of the usines, the native mandoors, or the unintelligent Chinese, because, after the last dressing given to the soil, the fields of cane are unexceptionable in appearance; but when the time is come for cutting them, it is found that the shoots at the head of the cane are not yet ripe, and if they are passed through the mill separately they will yield juice only marking 5° Baumé. Thus it is necessary to delay the cutting of the canes.

To prevent the formation of these tardy shoots, which have not time to ripen, and to have the canes ripened uniformly, they should be planted at the end of October or beginning of November, in soil freely manured, but open and well drained; or the ratoons of this period should be preserved, and manured as soon as the first sprouting becomes general.

2nd and 4th. It has been noticed that some isolated plants of cane from Cheribon, called Tebboe Itam, have been found amongst the red cane of Batavia, and it appears also to be very similar to the variety known as Teboe Assep. However, although cultivated under precisely similar conditions, they have given very different yields, for the Itam has produced 4,044 lbs. sugar to the acre, and the Assep 4,934 lbs. to the acre.

So, also, we may remark that the Passoeroean Awoe, which is very similar to the Teloek-Djambie Awoe, has returned 3,670 to the acre, whilst the latter yields 4,051 lbs., a proof of the observation recorded by M. Rost van Tonningen, in his work on the degeneration and amelioration of the varieties of cane in Java, that a good species transplanted into different conditions of soil, climate, and culture, may greatly deteriorate; but after awhile, when it has adapted itself to new conditions, he believes it will regain the characteristics which distinguish it. The four propositions by which M. Rost van Tonningen sums up his *mémoire* are not contradicted by our researches; the third is in all respects confirmed by the results we have obtained, but further experiments are necessary to determine the limits within which the fourth should be accepted.*

* M. Rost von Tonningen has taken from the east of Java, cane which ordinarily contained 18 per cent. of sugar, but which, cultivated in Buitenzorg, a fertile and well tilled district, has only indicated (after eleven determinations) an average richness of 13 per cent. This rapid degeneracy is the result of a variety of causes, chiefly of greater humidity of the climate and of a lower temperature, consequent on greater elevation. The cane long cultivated at Buitenzorg has given in six analyses an average of 16 per cent. of sugar; this variety may be said to have improved, for in the Kampongs, whence it originally came, the juice rarely indicates more than 7° Baumé. M. Rost von Tonningen gives one instance of juice in the latter province, from well developed ripe cane, as only indicating 6° Baumé, and as containing only 10·64 per cent. of sugar, of which 2·77 per cent. was inverted sugar, or glucose. The four propositions referred to are as follows:—

1. That every region is peculiarly adapted to the culture of one or other variety of cane, the causes of which science cannot accurately determine.

I recommend to planters who wish to introduce new varieties of cane into their own estates to take particular note of the experiments I have made, and then to endeavour to discover what modifications the change of climate may effect on the variety which they propose to adopt. This is a field for inquiry, hitherto but little explored, the investigation of which may be very profitable.

In many parts, and in different factories where the manufacture is carried on quite as well as in other parts, the inferior results obtained can only be accounted for by the fact that the cane cultivated is less rich in good juice than in parts where the yield from the same cane is higher. Thus the introduction into the residency of Cheribon of the Itam cane, and its general propagation has notably increased the quantity of sugar produced there, to which result no alteration in the mode of manufacture has contributed.

3rd. The white cane known at Krawang by the name of Teboe rottan, and in Java as the bamboo, appears to be of good quality. There has always been noted in these canes a disposition to flower, either as plant canes or ratoons, in which case the canes are short and stunted. To escape this danger, it is recommended that this variety be planted either at the beginning of the year or towards the end, after the middle of October, and that canes cut before this period should not be kept for ratoons, for it has been proved that canes planted within the time indicated, or ratoons from canes cut after October 15, are seldom or never found to flower.

5th. The cane Njamplong, of which the plant came some years back from Sourabaija, may justly be considered as one of the best varieties of cane in Java. It has yielded juice marking 11·3° Baumé, a density rarely observed here. We have obtained from it a greater

2. That we shall be led to draw false conclusions, if we judge of the qualities of a variety of cane suited to a certain district, by the qualities shown by the same cane, when transplanted into conditions of inferior culture.

3. That the sugar cane, like a great number of other vegetables, is improved by continuous careful cultivation.

4. That it is not always advantageous, and that it may be imprudent to replace on a large scale, in a given locality, a good variety of cane by another variety which gives better results in a different region.

number of canes than from any other variety; but, from the small quantity of juice which they yielded, smaller than any of the others, it seems probable that the canes were not fully developed. In this result we only see an effect of their being transplanted, rather than conclude that it is one of their peculiarities to yield only a small quantity of juice; and that the conditions of culture which this cane demands had not been satisfied here. Further experiment has shown that this cane requires diluvial soil, very rich and very light, more sandy than clayey, or at least that it should be very easy to work, and not adhesive; further, that it needs abundant watering during the dry season, and repeated working about the stems, and, lastly, the presence in the soil of a large proportion of soluble mineral salts.

None of these conditions were realizable in our experiment, and even the abundant manure used did not prevent this variety from being later in development than the others. That it needs a larger proportion of soluble mineral salts than any other there can be no doubt, on seeing the quantity of hard leaves with which this cane is covered. The canes, too, are very hard and dry, very short between the knots, and these knots of a woody nature. This cane should then have more time, and during its growth should be supplied with more mineral salts than the other varieties, and as the roots are long, and penetrate deeply, it seems to indicate that a light soil would suit it best.

Thus, notwithstanding the advantages in its favour, we should not recommend the extensive culture of this variety of cane, except in very rich and suitable land. It would be interesting to try whether by strong manures, especially by those of commerce, such as guano, silicate of potass, powdered bones, sulphate of potass, sulphate of ammonia, &c., it would be practicable to obtain such a yield of juice from this cane as would compensate for the expense of the manures.

6th. There is little to be said of the Socrat cane. It is an average variety, not remarkable for any special excellence or defect.

7th. The Otaheitan cane differs considerably from the Njamplong

in some respects, but is similar to it in others. It equally prefers a light soil easily worked, and gives on fresh cleared lands beautiful crops of strong canes very juicy. It fears the drought, and can only be planted profitably at the commencement of the western monsoon. It needs fewer soluble mineral elements in the soil than the Njamplong, but it is only in virgin soil that it ratoons well. The sugar made from it is brilliant, and of a large crystal even when grown on rich soil; it may be grown advantageously in newly cleared forest land, dried-up marshes rich in humus, in which no other variety will yield such good results; but it must not be classed amongst the varieties to be chosen in all cases by planters, and the figures in the preceding tables will show this. When the Otaheitan cane is fully ripe, *i.e.*, when the knot is of a straw yellow colour, the juice will generally gauge 11° Baumé. When once it has become fully ripe it will bear the drought very well, and it is rare that it withers or dries up. The Njamplong has a great power of sending out-shoots, the development of which has to be favoured by manures which act slowly and for a long time, or by the natural richness of the soil. With the Otaheitan cane, on the contrary, it is necessary that the manure should act rapidly during the youth of the plant, to facilitate the formation of numerous shoots from the root.

8th and 9th. The results of the culture of the two varieties of Awoe are sufficient to show that both should be rejected by the sugar planter, unless, indeed, careful and long continued culture should prove that it is possible to increase their saccharine richness. Their rejection is the more desirable, because it is only by long practice that they can be distinguished from No. 3, the white cane, with which they are often mixed in the plantations. Once this mixture is made, the whole plantation soon becomes changed into Awoe, because the white cane often flowers, and the Awoes seldom or never, so that the latter consequently furnish a larger supply of new plants every fresh planting. We recommend planters to examine closely whether they have the Awoes in their cane fields, and carefully to reject them, and especially not to permit them to serve as plants for new plantations.

M. EM. ROUSSEAU'S SUCRATE OF LIME PROCESSES.

From the "Journal d'Agriculture Practique." *

OF all the processes and improvements for the manufacture of sugar which have been brought out of late years, there is none so well calculated, both by its principle and long period of use, to exert a direct and considerable influence on agricultural and manufacturing industry as that of M. Em. Rousseau, based on sucrate of lime.

The origin of this process dates so far back that a complete history of it is unnecessary. The works of Pelouze and Peligot have long since demonstrated that cane or beet-root sugar in combination with lime is not altered in condition, and may be extracted without change in its properties. M. Kuhlmann noticed from experiments which he made in his laboratory, in 1838, that sugar possessed greater stability when united to lime than when alone, and he suggested, as a practical application of this fact, to eliminate by carbonic acid the lime in combination with the sugar in the juice submitted to defecation, in order to avoid the employment of animal charcoal.

The credit of the realization of this suggestion belongs entirely to M. Em. Rousseau. Vaguely known by his name, or under that of *saturation*, this process consisted in a methodical defecation, by a

* Since the publication in the "*Journal des Fabricants de Sucre*" of the account of the application in a French refinery of Messrs. Boivin & Loiseau's patent for refining sugar by the sucrate of hydrocarbonate of lime, a notice of which appeared in the last number of "*The Sugar Cane*," the process has undergone considerable discussion in some of the French journals, the object of several of the writers being to show that what is useful in Messrs. Boivin and Loiseau's process is not new, and that what is new is of questionable utility. Into the merits of the controversy we have no wish to enter, but, not entirely to pass it over, we give a translation (somewhat compressed) of part of a paper, of more general interest than some that have appeared *apropos* of the subject.—ED. *S. C.*

quantity of lime proportionate to the amount of foreign matters contained in the juice, carried on at a low temperature; then the neutralization of the lime by carbonic acid. Instituted in 1849, with the assistance of Messrs. Cail & Co., the Rousseau process has gradually worked its way into the sugar manufacture of Europe, and, notwithstanding a series of modifications and numerous improvements in detail, it is the process almost universally practised [in the beet sugar manufacture] at the present time.

Amongst the modifications, those of M. Em. Rousseau himself chiefly deserve our attention. Thus, in 1861, he proposed to treat the juice whilst in the boiling copper with some thousandth parts of sulphate of lime, in order to unite all the coagulated albuminous matters into a dense scum. The clear purified juice was then to be agitated with hydrated peroxide of iron (at a temperature below *boiling*, as that fixes the colouring matter). After the separation of the oxide, nothing remained but to concentrate. This variation was not found to be practicable. Again, in 1864, M. Rousseau proposed to substitute for oxide of iron the sucrate of lime, that is to say, a combination of sugar and lime, solid, insoluble at a low temperature, and allowing the sugar of juices and of syrups to be preserved in this form for any length of time, and rendering the manufacture easy on the farm. And, lastly, as a sequel to this improvement, M. Rousseau invented a new decolorizing charcoal, the cost of which was so low that it might be utilized as manure, or even thrown away after use, instead of being revivified. Careful study of the properties of bone charcoal had convinced him that the decolorizing power resides essentially in the nitrogenous matter; he therefore replaced the framework of the char, *i.e.*, the phosphate of the bones, by clay, which he calcined with 25 per cent. of other matters, and obtained from this mixture a powerful and excellent charcoal.

The sucrate of lime improvement, described by M. Rousseau in 1866, has given rise to a system which is in full activity at the present time, and which completely answers the expectations he then entertained, and, if we are not mistaken, it will eventually revolutionize the sugar industry of Europe and the colonies. As it

is practised, it is based on the transformation of crystallizable sugar contained in any vegetable juice whatever (or in syrup obtained in the process of manufacture) into a product possessing the following important properties:—

The sucrate of lime is solid as sand, more or less coloured, according to the colour of the juice or syrup from which it is produced. Insoluble in concentrated saccharine solutions, and nearly insoluble in cold water, it is soluble in hot water, and in a saccharine solution of twice its own strength; unfermentible there is no possibility of its becoming mouldy or undergoing decomposition; from its alkalinity it is free from noxious animalculæ, and it will keep for an indefinite period. Sucrate of lime, in its fresh humid state, contains 40 to 50 per cent. of crystallizable sugar, and when dry, 70 per cent.; thus, in a small compass, and with an increase of weight of 30 to 40 per cent., may be concentrated the saccharine richness of any vegetable whatever, the cane, the beet, or the sorghum.

From these properties we may draw the following evident conclusions:—As raw material for the manufacture of sugar, the sucrate may be warehoused or transported, and may take its place on the markets. The quantity of lime it contains will not make the expense of carriage greater than that of raw sugar. The usines situated at considerable distances from the farms may be supplied with sucrate instead of beets, and thus the work of manufacture may be carried on during the summer.

Before further considering the economical consequences resulting from this product, some of the more important of its applications, based on its properties, may be described.

1. THE MANUFACTURE OF SUCRATE OF LIME ON THE FARM AND IN THE COLONIES.—The process being the same for the cane as for the beet, I will explain the treatment of the juice of the latter, as it might be carried on in the usine. After the ordinary defecation of the juice with the quantity of lime needful for the coagulation of the albuminous and caseous matters, the juice is evaporated from 30° to 82° of the areometer, and then allowed to cool, as it is the cool juice that is submitted to the *sucratation*. One can

imagine that the sucrate of lime being soluble by heat, the juice must be acted on at a normal temperature.

The sucratation copper is of sheet iron, circular, provided with a cover, and with a vertical shaft carrying horizontal paddles, and surmounted with a sluiced hopper, which allows of the quantity of lime necessary, to fall little by little into the copper below. This lime, which is finely powdered, has been slaked with a portion of water (*i.e.*, it is mono-hydrated); in proportion as it falls little by little, into the juice, the agitation in the mass is effected by the shaft with paddles. The combination of the lime and sugar thus takes place, crystalline granules are formed which agglomerate with increase of temperature; these granules increase in size, become denser, and but for the agitator which keeps them constantly moving in the saccharine fluid, would settle to the bottom of the vessel; furthermore, if the sucratation of the crystallizable sugar by lime were completed, the agitation ceasing for want of liquid, the whole would become a solid mass. One hundred parts of sugar absorb in the laboratory 14 parts of lime, and from 19 to 20 in the factory. Instead of pursuing the operation to the close, it is only half completed, and the product formed by the half of the syrup is let out by the bottom of the copper upon a sieve, where it drains, and from whence it is carried to a floor or stove to be dried. The other half of the syrup remaining in the copper, is made up by fresh cold syrup guaging from 30° to 32°, and the whole of this mixture is half sucrated as before; these operations are repeated in the same manner till the last copper in the day, when the *whole* of that is treated. As the product of this last operation contains the whole of the saline matters except that retained in the portions of the sucrate made in the preceding operations, it is set aside as impure sucrate. The sucrate of lime commercially obtained dries in the air, and loses from 27 to 30 per cent. of its weight of water. It may be calculated thus to contain 66 per cent. of sugar, 20 of lime, and 10 of water; once dry, it has a gray or brown appearance; in touch it is like manna, and crumbles between the fingers by strong pressure. Since it is almost insoluble in cold water, it may be freed from the small quantity of syrup which adheres to the grainy

mass by washing, by which means it is obtained purer and whiter; it may be consigned in hogsheads or bags without the least fear of deliquescence.

Thus we see that a sugar factory demands only the most simple apparatus; in addition to the ordinary apparatus for extracting the juice, rasper or mill, *or* press, boiler, and a large locomotive always useful on the farm or plantation, this is only required for the treatment of four to six thousand tons of beets, two defecating coppers of sheet iron, two evaporating pans, and a copper with apparatus for sucratation. It costs in short about £1200.

2. TREATMENT BY THE SUCRATE OF LIME IN THE PRESENT SUGAR MANUFACTURE.—It is only commencing with the syrups of the first crystallization that the sucrate of lime is formed in the method of manufacture at present pursued. Thus the rasping, pressing, defecating, and filtering proceeds and the sugar of the first crystallization is made as in the ordinary process; the syrup proceeding from this is, as is well known, very impure; it marks 32° on the areometer. The density is lowered by fresh juice already defecated, and it is then half sucrated as has been indicated in the first treatment, and the half sucratation is continued up to the last, where all the salts are concentrated, this is fully sucrated and the product set by itself. Thus the first day's operations consist in the manufacture of the first crystal sugar, and the sucratation of the drainage therefrom.

On the second day the sucrated sugar, previously crushed is shovelled into juice slightly heated by steam (54° to 70° Faht.) in the ordinary carbonatation apparatus. The liquid thus treated by carbonic acid in the presence of the powdered sucrate, which is added incessantly, is raised from a density of 2° to 12° or 15°, without heating. The precipitate contains, besides the carbonate of lime, the colouring matters. The reaction which is effected in this carbonatation is easy of explanation; a part of the sucrate of lime soluble in hot water, or in weak juice in the presence of carbonic acid, increases the saccharine richness of the defecated juice, whilst part insoluble, is dissolved in the sugar juice in presence of this excess of sugar.

After the carbonatation of the beet juice, in which the sucrate obtained from the syrup of crystallization has been mixed, it is then decanted. The perfectly clear syrup contains about a third of sugar in excess of that which would have been given by the defecated juice without the sucrate. It is raised to boiling and allowed to settle before filtering, or it may be sent straight to the filter press, then without passing through animal charcoal, be boiled and crystallized. The operation is continued in the same manner upon the lower syrups, until all the crystallizable sugar has been removed. When there is an excess of glucose, which the alkalies colour brown, it is well to carry on the carbonatation until the liquid shows only a faint alkaline reaction; boiling then precipitates a little of the carbonate before filtering.

The sugar direct from the vacuum pan is without taste of beetroot, colourless, and is fit for direct consumption. A modification of the turbine would even allow of its being obtained in slabs, which might be stoved, cut up into pieces, and packed in boxes.

Up to lately, sucrate of lime had been made in weak solution, which occasioned great cost in evaporation, and perceptible deterioration of the product; thanks to the researches to which the divers recent applications have given place, the process is conducted, as we have just shown, in the most simple manner, by producing it directly, and without evaporation, ready for the vacuum pan.

Thus, in mixtures containing uncrystallizable sugar, by limiting the quantity of this sugar to be sucrated, we are able to accumulate in the residual syrup as much as 13 per cent. of foreign salts, the sucrate containing only 2 per cent.

To conclude, from this reaction, such as we have described, proceeds a decoloration of even inferior syrups, which dispenses with the use of animal charcoal. We may thus anticipate that we shall be able even in the refinery to decolorize directly by sucrate of lime, thanks to the floculent precipitate, which is formed by the decomposition of the carbonate, and which takes with it the colouring matters, without employing processes so expensive as those patented by Messrs. Boivin and Loisean, or which involve the use of animal charcoal and bullock's blood.

MANURE FROM THE SEA.

(*From the Journal de l'Agriculture.*)

DURING hundreds of generations the rivers have been rolling to the sea an enormous quantity of fertilizing elements derived from the surface of the earth. All these principles of life in plants and animals are not lost; they serve to vivify and multiply the innumerable creatures that inhabit the ocean. But a time may arrive when man, having incessantly obtained exhaustive crops from the soil, may see the fruitful earth become sterile. The law of restitution to the soil of its fertilizing elements is imposed on him: whence are they to come? The time is fast approaching when the deposits of guano will be exhausted, whilst those of fossil phosphates do not appear to be very extensive, and in no case do they supply more than a single fertilizing principle useful to vegetation. The sea, on the contrary, presents inexhaustible riches. To draw from the ocean not merely food for man, and material for divers products of his industry, but further to obtain from it a manure (equal in value to guano) which exists therein in illimitable quantity, is a problem which civilised society will be forced to solve, the more important as it presents the only means of largely augmenting the mass of matter needful for the surface of the earth. We must extract from the sea to return to the continents.

A French manufacturer, M. Rohart, has been the first to succeed in preparing from the refuse of fish a manure comparable in richness to the best Peruvian guano, *i.e.*, to the most effectual and powerful of manures known up to the present time. M. Rohart has had the enterprise to establish a manure manufactory in the Loffoden Isles, near Kerkevaagen, in the centre of the sea fisheries of Norway. There twenty to twenty-five thousand fishermen take every year from the depths of the sea a weight of 100,000 tons of fish. Until this last year or two, one-third of this weight, say 30,000 tons, has been thrown into the sea; M. Rohart has shown that this may be utilized, and the fishermen now sell the heads of the codfish at the price of 1·45 fr., and the vertebræ for 1·50 fr., per

hundred kilos. The collection of the viscera has not yet been commenced, but they may be bought at a still lower price than the heads or the vertebræ.

One hundred kilos. of the dry matter of this refuse, of a richness nearly equal to that of guano, and which contains 8 or 9 per cent. of nitrogen, and nearly 30 per cent. of phosphate of lime, only costs in Norway 12 or 15 frs. (£5 or £6 per ton). The bones of whales, dog fish, herrings, seals, and other marine animals, would be equally valuable, and some even more so, both for agriculture and manufacture. The enterprise of using the sea with a view of improving agriculture cannot be too much encouraged. The Emperor Napoleon III. comprehends this necessity, having, as we know, aided the founding of the establishment of M. Rohart, in Norway, with a sum of 100,000 fr. This is a noble example of an intelligent beginning. All the friends of agriculture, whether in France or in any other civilized country, ought to applaud and try to encourage this new industry of using materials from the sea to fertilize the earth. The question is one of paramount interest, and deserves more consideration than those vain disputes which unfortunately absorb, for the most part, the attention of statesmen.

CUBA AND ST. DOMINGO.

(*From the "Journal des Fabricants."*)

By advices from Havana under date 22nd February, we learn that the Spaniards are much opposed to the projected annexation of St. Domingo to the United States. They consider that the result of this union would be to rob the island of Cuba of a great part of its wealth, since the quasi-monopoly of sugar growing for the States would be taken away. The resources of St. Domingo and the contingency of the competition of the planters of this island with those of the neighbouring islands are not generally taken into account. The soil of St. Domingo is unrivalled for the

production of the cane. In the year 1789, the time of the greatest prosperity, the sugar crop realized 21 millions of dollars (over four millions sterling). Fifteen years ago sugar was still exported from St. Domingo to Cuba. If the annexation takes place the Americans will devote the island chiefly to cane cultivation, and it will not be long before it produces sufficient sugar for the whole of the United States. This sugar will have the advantage over that from Cuba, since it will not pay duty; now the States import annually Cuban sugar to the amount of five millions sterling, whilst the value of sugar exported from the island to England and the other European countries does not reach two millions. If the American demand fails the planters of Cuba, they will seek a market for their produce in Europe, the price of sugar will soon fall considerably, and thereby the wealth of the island will be diminished.

What would be the consequence? That Cuba would no longer furnish magnificent revenues to the Spanish Government. The numerous coloured labourers [slaves] in Cuba would still be a source of some advantage over St. Domingo, but the island would no longer be as at present, a mine of wealth where the ruined placemen of Spain may go to repair their fortunes. This is the reason that the Spaniards are so much opposed to the projected annexation of the republic of St. Domingo to the United States.

NOTE ON THE ESTIMATION OF MOISTURE IN NEW CHARCOAL.

By Geo. Manley Hopwood, F.C.S.

In No. 2, Vol. I., p. 116, of "*The Sugar Cane,*" is a memorandum on the estimation of moisture in new char, by Dr. Wallace. From the experiments therein stated, Dr. Wallace recommends that the char should be heated to 350° Faht. for ten minutes. In most of our sugar refineries air and oil baths are not a part of the laboratory furnishings. To ensure accuracy of result by means of the most general apparatus is a desideratum. Lately I made a few experi-

ments with the view of testing the accuracy with which moisture could be estimated in char over an ordinary Bunsen's flame. To check the results, the water driven off from char heated to 350° Faht. (the requisite temperature, as proved by Dr. Wallace) was collected in a chloride of calcium tube and weighed. The Bunsen flame should be about one and a half inches long, and the top ought to just lick the bottom of the covered crucible. The crucible is allowed to cool in a dessicator previous to being weighed. Duration of heating, ten minutes.

Char.	By heating for 10 minutes over $1\frac{1}{2}$ in. Bunsen flame. Moisture per cent.	By weighing water driven off at 350° for 10 minutes. Moisture per cent.	Difference.
1	10·54	10·32	+0·22
2	7·62	7·36	+0·26
3	13·72	14·03	—0·31
4	13·10	13·22	—0·12
5	9·60	10·00	—0·40
6	10·07	9·54	+0·53
Mean ..	10·77	10·74	

The differences between the two methods are not so great but that they may be accepted as due to manipulation. The second method is the more difficult, and requires greater care to ensure accuracy.

These results show that the moisture in new char may be determined even over a naked flame, if a small amount of care is exercised. In all cases of dispute, however, the method of collecting and weighing the water is the most preferable.

Population of Cuba.—From the *Revue de Cours Scientifique* we learn that the population of Cuba has increased in greater ratio than that of any other part of the world, except the United States. The present population of Cuba is over two millions.

LECTURE ON SUGAR IN EDINBURGH.

WE are glad to see that a degree of interest is being manifested in sugar in various quarters where formerly little or no attention was paid to it, and perhaps we may be pardoned when we take some little credit to "The Sugar Cane," as helping to arouse and spread that interest.

On the 8th of this month, Mr. John Nicol, F.R.S.S.A., Lecturer on Chemistry in the Royal High School, Edinburgh, delivered a lecture on "The Story of a Tierce of Sugar" to the "Grocers' Association" of that city. There was, it appears, a large attendance of grocers and others interested, and the lecture was listened to throughout with evident pleasure, and frequently applauded.

The lecturer treated the subject under three heads, or divisions:

1. Sugar as a Manufacture.
2. The Chemistry of Sugar.
3. The Physiology of Sugar; *i.e.*, why we eat sugar, and what it does for us.

Under the first head he described briefly, but graphically, the cultivation of the cane from its first planting till ready to be punted to the mill. In speaking of the value of megass as a fuel, he stated that, as he would show bye and bye, the sugar was almost entirely taken by the cane from the atmosphere, and it was of the utmost importance that as much as possible, both of the megass and the insoluble matter in the liquor, should be returned to the soil, and expressed his surprise that in Demerara, the country to which his description was specially applicable, it was only recently that the managers had seen the necessity of using the ashes of the megass in this way, although the colony for a number of years kept an agricultural chemist, who ought to have taught them better. The whole process of boiling, both on the old copper wall and in vacuo, was then lucidly explained, and illustrated by diagrams, and this division wound up with statistics of cost of production, quantities consumed, &c., &c., including some severe censure of the present system of levying the duties.

Under the second head he alluded to the great variety of sugars

known to chemists, but specially noticed only the cane sugar and grape sugar. The sugar was then decomposed into its elements, carbon, hydrogen, and oxygen, and the properties of each explained and illustrated by a series of striking and successful experiments, special attention being directed to the heat resulting from the union between carbon and oxygen.

In speaking under the last head, he showed that our food may be divided into two classes, the alimentary nutritive and the alimentary respirative, that sugar belonged to the latter class, and contained in the form most easily acted on, the elements most especially required to keep up the temperature of our bodies to the required degree.

The lecture was a decided success, and we hope to see the example so well set by Mr. Nicol, followed in many other cities.

THE BEET-ROOT CULTURE IN ENGLAND.

By a (French) Correspondent of the *Journal de l'Agriculture.*

Some time ago we were present at the scene of some remarkable operations, which it may be interesting to note.

After having for many years furnished to our national agriculture and to the world at large those admirable instruments which have contributed so largely to the progress of field operations, the English and American inventors now witness in their own countries an opposite order of things. We have not only returned to them their own inventions mnch improved, but we have also furnished them with original apparatus, which they have applied with success to their own agriculture. For instance, we have had to complete in England the installation of the first beet-root distillery.

This establishment is situated on the beautiful estate of Mr Robert Campbell, formerly member of Parliament, a very able agriculturist, who has erected works at Buscot Park, which excite our surprise no less than our admiration.

We will give a few details of this agricultural establishment, which comprises about 5,000 acres of land, and on which a distillery

of the largest size has been erected, which supplies refuse enough to feed 12,000 sheep and 2,500 oxen. The beet-root, contrary to established prejudice, flourishes well in England, Mr. Campbell has obtained this year, on the first trial, about 40 tons to the acre, and these roots, according to analysis of Mr. J. Barral, chemist, of London, contain 10 to 12 per cent. of sugar.

The steam ploughs, and other powerful agricultural machinery employed by Mr. Campbell, answer admirably for the culture of the beet, which requires very heavy labour perfectly to prepare the soil. The steam ploughs are on Mr. Fowler's principle. They are capable of turning over the soil to the depth of a metre (39in.), and each of them can prepare about 25 acres in 24 hours (they work night and day). Mr. Campbell estimates the cost of steam ploughing at about 2s. per acre, whilst to execute it with horses or oxen would cost nearly 10s. per acre.

To give a true picture of Buscot Park would require a volume. It would be necessary to show how the Tamise, which bounds this great establishment, furnishes enormous hydraulic motive force applied to the work of irrigation, conducted on a vast scale. It would be needful to describe the immense central basin, the compartments above which will contain three millions of cubic metres of water destined to fertilize the fields. But we must leave all this to more competent pens, and return to the distillery itself.

The extraction of the beet juice is conducted by Mr. Collett's system of presses, of which nine are already set up, and there are facilities for the erection of twenty. The presses already worked extracted the juice from 100,000 kilos. (about 98 tons) of beets in ten hours. The fermenting vats contain above 6,000 gallons each.

Entering the vast space allotted to machinery, we find it already occupied this year by two enormous stills and a rectifier on the French system, with room for doubling the apparatus in course of time. Mr. Campbell has had the happy idea of adding to the buildings purposely erected for his machinery a magazine capable of containing all the alcohol produced in one season. For this purpose some vast metal cisterns have been constructed to contain the spirit without fear of leakage or evaporation, ready for delivery according as the markets are favourable.

ON THE ESTIMATION OF THREE KINDS OF SUGAR IN ONE SOLUTION.

BY A. DUPRE, Ph.D.,

Lecturer on Chemistry at Westminster Hospital.

(*From the "Chemical News.*")

FOR some years past I have been constantly in the habit of estimating two, and sometimes three, kinds of sugar present in one solution, by the conjoint use of the chemical and optical methods. The plan adopted by me differs from that of Professor Apjohn, described in the *Chemical News* (vol. xxi., p. 86), and, I believe, solves the same problem in a more direct manner. This problem is the estimation of cane, grape, and fruit sugar, when present in the same solution. Invert-sugar is a mixture, or compound, of fruit and grape sugar in equivalent proportions, and its amount can therefore readily be calculated if the amount of these two sugars be known.

Now, cane sugar does not reduce the cupric solution, and is not affected by heating with a dilute solution of caustic alkali. Both grape and fruit sugar, however, reduce the cupric solution, and both are readily destroyed by being heated with a solution of caustic alkali. We can thus estimate the amount of cane sugar by its rotative power, having previously destroyed the grape and fruit sugar; we can estimate, chemically, the aggregate amount of these last two sugars, quite independently of the presence or absence of cane sugar. We have now only to estimate the amount of rotation due to the three sugars jointly, and are then in possession of all the necessary data for the quantitative estimation of each.

It will be seen that the cane sugar is estimated by direct observation; and the problem thus, in reality, resolves itself into the estimation of a mixture of grape and fruit sugar. The amount of rotation produced by these two being estimated directly, if cane sugar be absent; indirectly, in the presence of cane sugar, by sub-

tracting the rotation due to the cane sugar from the rotation produced by the three sugars jointly.

The instrument employed by me (one of Professor Jellet's beautiful saccharometers) has a 10-inch tube, in which a solution containing—

1 per cent. cane sugar, required for compensation 0·2418 inches left-handed turpentine.

1 per cent. fruit sugar, required for compensation 1·502 inches of a 10 per cent. cane sugar solution.

1 per cent. grape sugar,* was equivalent to 0·836 inches of 10 per cent. cane sugar solution.

Now, let x be the amount of fruit sugar sought; let y be the amount of grape sugar sought; let p be the sum of both sugars found by the cupric solution expressed in percentages; and let a be the number of inches of 10 per cent. cane sugar solution which has been found to compensate, or be equivalent in rotating power to, the mixture p of fruit and grape sugar present.

We have then the equations—

$$x+y=p$$
$$x\times 1{\cdot}502-y\times 0{\cdot}836=\pm a$$

and

$$x=\frac{p\times 0{\cdot}836\pm a}{2{\cdot}338}$$
$$y=p-x$$

As regards a, the sign $+$ is taken if the mixture of the two sugars turns to the left, and requires to be compensated by the cane sugar solution; the sign —, if the mixture turns to the right; in which case a represents the number of inches of 10 per cent. cane sugar solution equal in rotative power to this mixture, as estimated by the left-handed turpentine, calculated, of course, in either case, for the 10-inch tube.

I have employed the foregoing method only for estimating the amounts of these three sugars present in wines, but it is, no doubt, equally applicable to crude sugars and syrups.

* I have throughout taken grape-sugar at 100°, when its composition is $C_6H_{12}O_6$, the same as fruit-sugar.

Import and Production, Consumption, Export, and Stock of Sugar in the United States of America, for the last 13 Years, to 31st. December.—*From H. E. Moring & Co.'s Circular (New York).*

	1869.	1868.	1867.	1866.	1865.	1864.	1863.	1862.	1861.	1860.	1859.	1858.	1857.
Imported to New York:	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
from Cuba	223,573	206,952	173,942	184,118	197,577	124,748	138,317	133,923	145,005	183,545	144,615	136,443	131,986
,, Porto Rico	18,973	20,140	16,481	20,394	15,926	6,420	9,646	15,808	19,220	22,705	15,967	20,705	14,034
,, St. Croix................	1,551	2,254	1,873	2,054	178	28	337	734	152	103	38	335	228
,, Brazil	10,180	3,778	1,638	5,178	3,622	1,796	4,671	3,856	2,802	5,098	8,165	1,759	2,772
,, Manila	14,589	8,866	3,129	3,695	4,460	5,001	3,119	4,139	4,877	3,322	2,751	603	2,827
,, Singapore, Java, China, &c.	874	218	761	2,917	184	424	89	92	1,098	5,390	2,338	1,757	3,562
,, the British, French, and other West India Islands	21,588	16,100	5,318	8,836	6,929	1,662	6,595	5,087	3,643	4,052	3,438	1,532	6,535
,, Europe and other Foreign Ports	1,007	765	276	2,212	715	368	1,422	3,281	....	....	....	....	....
Total Imported to New York ..	292,335	259,073	203,642	229,404	229,591	140,447	164,205	166,920	176,797	224,215	177,312	163,134	161,944
,, Boston......	57,786	62,237	40,886	53,542	39,298	28,135	28,370	28,366	30,028	44,927	31,138	29,473	31,720
,, Philadelphia.	56,704	66,121	50,658	52,620	40,210	24,140	27,670	29,741	20,852	28,215	24,696	23,791	22,802
,, Baltimore...	57,213	53,458	35,241	38,182	27,655	14,401	16,562	16,658	11,137	28,619	16,756	20,227	18,080
,, New Orleans.	21,530	19,706	16,094	19,523	14,469	726	214	....	526	6,682	2,213	4,861	20,349
,, other Ports..	15,786	10,380	9,280	10,226	11,020	7,570	6,116	5,330	3,568	8,874	10,714	13,614	14,287
Total Imports ..	501,354	470,975	355,801	403,497	362,243	215,419	243,137	247,015	242,908	341,532	262,829	255,100	269,182
Sugar produced in the States, 1868-69, 1867-68, &c.	45,000	23,000	22,500	8,500	5,000	28,000	56,000	235,858	117,400	113,900	177,900	137,351	36,327
Total Imports and home produce..	546,354	493,975	378,301	411,997	367,243	243,419	299,137	482,873	360,308	455,432	440,729	392,451	305,509
Consumption of Foreign Sugar...	447,899	446,533	378,068	383,178	345,809	193,980	231,308	241,411	241,420	296,950	239,034	244,758	241,765
,, Home Sugar	45,000	23,000	22,500	8,500	5,000	28,000	53,000	191,000	122,399	118,331	192,150	143,734	39,000
Total..........	492,899	469,533	400,568	391,678	350,809	221,980	284,308	432,411	363,819	415,281	431,184	388,492	280,765
Exports	13,793	8,246	6,231	7,444	3,551	20,920	5,397	9,774	29,868	13,234	14,194	12,525	28,705
Stock of Foreign Sugar in all Ports	81,604	41,942	25,746	54,244	41,369	28,486	27,967	21,735	25,915	54,295	22,947	13,346	15,529

THE SUGAR REFINERY AT EAST POINT.

(*From the "Hong Kong Daily Press."*)

IN the last number of Alsop & Co.'s San Francisco market report, there are some remarks with reference to the sugar refinery of that city, which are of interest in connection with the factory of Messrs. Wahee, Smith & Co., at East Point. As the subject appeared to bear upon the interests of the colony, an opportunity was taken to visit the above-named establishment; and from the particulars that have been obtained, there appears good reason to consider that it will form an active competitor with that of our enterprising cousins across the Pacific. The refinery at East Point will, when the new machinery, which has recently arrived, has been fixed, and the factory is in full working order, be capable of producing something like 40 tons a day, while that in San Francisco produces about 60 tons, figures which will give an idea of the extent to which this establishment has become developed in the course of twenty months, since the ground on which it stands was levelled. Those who are under the impression that the days of enterprise in Hong Kong are at an end, would be astonished by a visit to the works now being erected, and which it is contemplated will be completed within two months. The new house itself is an imposing building, rising to a height of over 60 feet.

It may be interesting to notice in connection with the account of the San Francisco refinery, that the slab process has been practiced at East Point from the commencement of the establishment's operations, and is therefore not quite so novel as appears to be believed, and the conclusions as to the extra cheapness of the San Francisco sugar are based upon misapprehension.

The progress of this enterprise, which is now placed beyond doubt, notwithstanding the gloomy predictions in some quarters to the contrary, is a satisfactory evidence of what still may be accomplished by energy and a determination to find the practical means requisite for the attainment of the end in view, in Hongkong; and and the assistance given too, in a variety of ways, by H. E. the

Governor, is deserving of much credit. The rum distillery, the ordinance with reference to which it will be recollected received his support at the last meeting of the council, is now being rapidly forwarded, and will probably be completed in about three months.

SUGAR CROP IN BARBADOES.

(*From "The West Indian."*)

Sugar making has become more general, but the sugar comes slowly to town, no further shipment having been made since by the *Nebula*. We have heard of sales at 4 dollars and 4¼, the latter a lot of 20 hhds. from *Fraser's*, netting £19 16s. per cask. The refineries in the Bay and on the Pier Head have both been at work, producing splendid samples of white sugar, equal to anything imported from England, which they offer at 5d. the pound. Muscavado (by the cask) is worth 2d. per lb., and allowing the same for cost of converting it into refined, that would leave a profit of a penny per lb. to the refineries, say £7 10s. per cask, supposing a ton of Muscavado to yield 1,800lbs. of refined, which ought to pay, and no doubt it would be so, if the demand for this kind of sugar for consumption in the island was sufficiently great. But as it is far from being so, the success of the experiment must depend upon the price in the home and foreign markets, which at present is governed by the duties imposed on sugar. The abolition of the duty or a uniform duty, would have the effect of extending the business of the refineries, and increasing the number of them in every part of the island, by compelling the planters to resort to them for the improvement of their produce. In a short time Muscavado would be driven out of the market, and Barbadoes would export crystallised vacuum pan, and white refined instead. Some are of opinion that this would not be to the benefit of the small proprietors, who cannot afford the expense of putting up the machinery required for the manufacture of this kind of sugar. The difficulty might be met by central factories, as in the French Islands,

and by making syrup to be converted into sugar at the refineries. But this is a question for the future; in the mean time it is enough for us to say, that the rain fall for February has been under two inches, where it has been highest, and generally under one inch, whilst it ranged from two to five inches in January, and the consequence has been the canes have ripened fast, and the reaping of the crop is pushed on vigorously. The yield is reported at about two hhds. per acre, with a strong quality sugar. The weather has been equally favourable for the young crop, which is well established and very promising. Native provisions as well as imported are plentiful and cheap, there is employment for all who are disposed to work, and the health of the island is good. We had showers yesterday and again this morning early. The weather is cool and pleasant. The bay is well filled with vessels awaiting sugar.

We can understand that it may be profitable to refine the sugar used in Bardadoes, on the island itself, rather than to have freight to pay both ways by importing it from Europe; but whether it will pay to refine sugar for export to England is another matter, if even the duty is totally abolished, as we wish may be the case. Very rarely it is found to be to the interest of the producer to become a manufacturer as well, and we doubt whether sugar would prove an exception; the true interest of the sugar producing colonies would seem rather to be, to increase their produce as far as possible, and simplify the processes of preparation for market.—*Ed. S. C.*

PLANT CANES IN MAURITIUS.

SOME time ago, as our readers will remember, in consequence of the disease with which the canes in Mauritius had become infested, a large number of cane plants were imported into that island from Egypt, New South Wales, Queensland, New Caledonia, and other parts. These cane plants have been cultivated and increased in the Botanical Gardens of the island, and sufficient

numbers being in a thriving condition to make it worth while, the greater part of them have by this time been distributed amongst the planters of that island.

It appears that nearly 30,000 plants of twenty-two varieties have been successfully cultivated in the Gardens in the following proportions, of which the names of many will indicate the parts from whence they were obtained:—

Teboe Soerat, No. 1	2945	plants.
,, ,, No. 2	260	,,
,, Njamplong	1269	,,
,, Lielien	2725	,,
,, Kœnig Pœlœ Penang	720	,,
,, Rappœ Var	2765	,,
,, Ayœna	2328	,,
,, Maeera	3487	,,
,, Portii	318	,,
,, Djœng Djœng, No. 1	176	,,
,, Rappœ	200	,,
,, Chigaca, Grand Cane of New Caledonia	137	,,
,, Itam	398	,,
,, Malaman	3400	,,
,, Banteng	419	,,
,, Yellow and Green Cane (Indes Occidentales)	3685	,,
,, Trinidad	460	,,
,, Guyane	114	,,
,, Anson	3150	,,
No. 1, Queensland, No Name	200	,,
No. 2, ,, ,,	166	,,
	29,821	

The Committee of the Chamber of Commerce, under whose auspices these canes were imported and planted, visited the gardens, and recommended to the Chamber that, taking for granted that the one hundred and fifteen sugar planters of the island would wish to have a share of the plants, the greater part of them should be divided into lots of about 200 each, and charged for at the rate

of three pounds sterling per lot, representing rather less than 4d. for each cane, the whole producing £450; and that should any lots not be claimed by a certain date, planters already supplied should be allowed to purchase any lots remaining at the same price. The remainder not divided will, we presume, be cultivated and increased in the Botanical Gardens for future emergencies. The Governor has signified his approbation of the course recommended.

We trust that record will be kept of the comparative advantages of these various species of cane, and that the example of Mauritius will be followed by several of the West India Islands, in the introduction from other colonies of new varieties of cane.

PLANT FOOD.—SILICATES.

(*From the Journal of the Agricultural Society of New South Wales.*)

OF the several materials which vegetation requires for promoting successful growth, there is one class of bodies known as the silicates which have most important duties to discharge. These are all compounds in which silica enters into combination with other bodies. In general terms it may be said that as the phosphates give firmness and rigidity to the skeleton of the animals, so do the silicates give stability to the vegetable tissues, and thus contribute to the perfect development of the plant. In some cases we find that where exceptional strength is needed, or special protection is necessary, there the silica is particularly abundant. The stalk of wheat is a special instance of this kind, for not only have the tissues of the plant received their ordinary supply, but a coating of silica surrounds and strengthens the straw and enables it to carry its heavy load.

An examination of the ashes of plants has shown the presence of silica in every cultivated plant, and that it constitutes a large proportion of the mineral matter taken up by growing crops. It is, therefore, an essential of successful growth. All our soils contain

a large supply of silica, some in a condition readily available for vegetable growth, and much becomes so by the processes of cultivation and the action of manures. The question very naturally arises, is it necessary to make any special provision for the supply of a body which is so generally abundant? The inquiry is just, and shall be fairly met. To facilitate this explanation, it should be stated that silica generally exists in our soils combined with alumina, in which form it is insoluble in water, and therefore so far valueless to vegetation. There are, however, various agencies by which it is made available.

Of these agencies, the most influential is undoubtedly the carbonic acid which is carried into the soil in rain water. It is most influential because of its constancy, rather than from any intensity of action which it exerts, but it must be regarded as the natural means for providing plants with silica. The silica being thus detached from its old association, now needs either potash or soda, with which to form a new alliance, and thus become prepared for entering into the plant. In fertile soils these bodies are present, and therefore the passage of rain water, carrying a supply of carbonic acid into the land, changes the insoluble silicate of alumina into a soluble silicate of potash or soda, and thus gives the growing crop the supply that it needs. If, however, potash and soda are absent, this change does not take place, consequently the proportion of potash or soda in the soil indicates the proportion of silica which can thus become available. Thus, although silica is abundant in all soils, and these receive the carbonic acid which sets the silica free, still the necessity exists for the action of other bodies, which in many cases are very limited in their supply. The addition of potash or soda to such soils would in such cases not only supply potash or soda, but the silica would be carried into circulation at the same time. It is by no means probable that it will ever be necessary to add to the soil supplies of silica, but it is highly probable that provision may have to be made for rendering the silica which exists there available for vegetable growth.

Important as the silicates are to vegetation as food, there is another function which they discharge, which is of the deepest

importance for maintaining the fertility of the land. We recently laid before our readers an explanation of the important discovery made some few years since by Professor Way, showing that there exists in some soils a class of salts which he named the double silicates. The action of these double silicates is peculiar, and their influence very important. It has been shown by his researches that these bodies really act as purveyors of ammonia. They have the power of absorbing from the atmosphere the ammonia which exists there, and retaining it until the crop requires it for the purposes of growth. The soil, therefore, becomes a net for arresting ammonia, and it is capable of doing so to an extent very much greater than we can ever equal by any addition of ammonia in the form of manure. If we consider that at the present prices ammonia cannot be purchased, from the cheapest sources, at less than £60 per ton, we must recognize it as a very costly ingredient in our supply of artificial manures. Is it possible that, whilst we are sending to Peru for guano, chiefly because it contains an abundant and comparatively cheap supply of ammonia, that our soils can be made to gather large supplies from the atmosphere at a small cost? Of the fact there is no doubt. Let us hope that this discovery may no longer be allowed to slumber, but that it may be brought to bear in such a manner that it shall be of practical value to the farmer.

The action of these double silicates, although very remarkable, is easily explained. When silicia is conbined with alumina we get a silicate of alumina; when silica is combined with lime we get a silicate of lime. Under certain circumstances these two products combine with each other, and then we get a silicate of alumina and lime, which is one of the double silicates. There are several of these double silicates, for magnesia, soda, and potash can each take the same position as the lime, and form double silicates. The peculiar action of these double silicates is that when exposed to an atmosphere containing ammonia, or if rain-water carries a supply into the soil, the ammonia is immediately laid hold of. Whatever may be the second base which is in combination with the silicate of alumina, whether it be lime, potash, soda, or magnesia, it im-

mediately vacates its position in favour of the ammonia, and thereby this very valuable fertilizer is held captive until the claims of vegetable life call for a supply, and then it is surrendered. It has well been described as the most valuable discovery in relation to manures which chemistry has given us. To be of practical value it must be carried one step further, and some means must be adopted whereby the farmer can at will increase his supply of double silicates; and in proportion as he does so he will be obtaining a supply of ammonia at a cost very far below what he has now to pay for it.

We look upon the presence of silica in artificial manures as valueless and undesirable, and this opinion is doubtless correct. We must not, however, forget that whilst it is impolitic to add to the soil a material which is already existing there in great abundance, it is one of the duties of an artificial manure to supply the agency for rendering the silica of the soil available whenever there is a necessity for it. In this way we shall supply silica by means of manure without adding it in the manure, and this is clearly the wisest policy. To complete the matter we must also adopt measures to increase the supply of the double silicates, then shall we have progressed satisfactorily in the use of artificial manures; but until this has been accomplished we must regard the work as very incomplete.

NEW PROCESS OF SUGAR CONCENTRATION IN AUSTRALIA.

MR. TOOTH, of Yengarie, has invented a new adaptation of the vacuum pan process, by which, it is said, he is able to effect a very speedy evaporation of the cane juice.

On the second of December last, as we learn from an Australian paper, Mr. Tooth gave some account of his process in a lecture on sugar delivered at the School of Arts, Maryborough. In the former part of his lecture he thus speaks of Queensland as a sugar growing country:—

"The capabilities of Queensland as a field for sugar cultivation have now been so thoroughly tried as no longer to admit a doubt of the plant succeeding to the fullest extent. We have fine crops of cane of vigorous growth, high density, and requiring as little skill in cultivatiou as in any part of the world. The plantations only require to be seen to establish this fact. Those who, like myself, have resided in Australia for a long time know, moreover, that the seasons are peculiarly favourable. From the time we commence crushing, until the season is over, we have the most favourable conditions for the accumulation of saccharine substance in the cane, the weather being generally dry and genial; but in February and March, when we require rain to push on the plant for another season, we can generally reckon on a bountiful supply. Whatever effect, therefore, the dry weather in spring may have on other productions, the course of the seasons is evidently most favourable to the sugar planters."

The great difficulty in the extraction of sugar appeared to Mr. Tooth to be to preserve it from exposure, and to evaporate it at a low temperature, and this he concluded could only be done by the vacuum pan, but so modified as greatly to increase its evaporating power. This he thinks he has effected by applying the heat outside, and apart from the vacuum space. This is done by means of a long cylinder, up which the juice is continually being forced by a force pump through a number of small tubes, which traverse the cylinder from end to end, terminating both at top and bottom in cisterns, which tend to produce a steady flow and discharge of the liquid. The juice having been raised to the requisite heat by its passage upwards through the tubes in the cylinder, enters at the highest level into another larger cylinder partially exhausted of air. The juice passes into this vacuum space through a large rose, having 2,000 perforations of an eighth of an inch in diameter, and falls to the bottom of the cylinder in a shower of globules, each of which gives up a portion of its moisture in descending, and the juice becomes a syrup at the bottom of the large cylinder, where it accumulates in a hollow, whence it is returned to the heating cylinder to pass again through the same process, until it is

ready to be granulated in the ordinary vacuum pan. The evaporating cylinder requires to be of considerable height, to afford the necessary space for the immense evaporating surface required by the minutely divided liquid. By this process, from 500 to 600 gallons of juice may be evaporated per hour, with only one man required to conduct this part of the operation.

The Australian paper, the *Herald*, which contained the report of Mr. Tooth's lecture, concludes some lengthy remarks on it by the following observations:—"Mr. Tooth's invention seems to promise a new era for the sugar growing districts of the eastern coast. The only drawback to the system seems to be that it is not a poor man's process, for the machinery is expensive, and the larger the scale on which it is carried on the greater the proportionate economy."

THE OSMOGENE.

The inventor of the Osmogene Process, for purifying molasses, M. Dubrunfaut, has lately reviewed in the columns of the *Journal des Fabricants*, the progress which his invention has made, and the extent to which it is adopted in the French Sugar manufacture. We are not aware that the process has been introduced into this country in a single instance, indeed, it is chiefly valuable for operating on beet sugar molasses, on account of the soluble salts, which are the chief impurities of this syrup, and which the Osmogene process is so efficient in removing.

M. Dubrunfaut first made public his adaptation of the principle of dialysis, in a work presented to the Academy of Sciences, in November, 1855, in which he announced that he had succeeded in applying the power of Osmose to the separation of certain mixtures.

Dutrochet appears to have been the first to study the peculiar behaviour (called Osmose) of saline solutions when separated from water, &c., by a diaphragm of a membranous nature. He was followed with greater accuracy of results by Vierordt, Professor

Jolly, and by the closer researches of Graham. The term Osmose derived from a Greek word signifying impulsion, comprises the two terms endosmose (diffusion through inwards) and exosmose (diffusion through outwards). The first experiment in connection with it was performed by suspending a closed bladder holding a saline solution in a vessel nearly full of water. The salts passed through the bladder into the water at a certain speed, and the water entered into the bladder at a certain speed, but the velocity of diffusion was not alike in each. The more rapid flow from the thinner to the thicker fluid was called endosmose, and the opposite slower current exosmose. It is this principle of dialysis, or diffusion, which M. Dubrunfaut successfully adapted to the purification of beet molassess and the extraction of sugar contained therein. These molasses are a mixture of sugar and different salts, chiefly nitrate of potash and cloride of potassium, which retard and in certain cases prevent the crystallization of the sugars which are present with them. If then the proportion of salts in the molasses can be diminished by whatever cause, the molasses will furnish a further quantity of crystallizable sugar.

This result M. Dubrunfaut obtained by placing in the endosmometer of Dutrochet molasses of the usual density in the presence of water, and then causing two currents to flow; a strong one forces the water against the molasses, the other more feeble, forces the molasses against the water, a diaphragm separating the two. The effect is such that the molasses parts with the greater part of its salts to the water, but with little or none of its sugar, so that the molasses remaining contains much less salts and nearly the same proportion of saccharine, which by the usual operations of the refinery may be separated in the form of crystallizable sugar.

Such is the principle of this mode of treatment of molasses and other saccharine liquids, and to the apparatus for carrying it out M. Dubrunfaut has given the name of an "*Osmogene.*"

In an osmogene there are two distinct reservoirs separated by a permeable partition. One of these receptacles contains the molasses or syrup, the other is filled with water; the medium separating the two liquids is of parchment paper.

Each receptacle consists of a casing, the top bottom and ends of which are of rather thick wood, whilst the sides are furnished with parchment paper; each casing is about three feet in length, two feet in breadth, and $\frac{3}{4}$ of an inch in thickness. Four bars of wood divide the interior of the casing lengthwise into five compartments, which communicate with each other by an opening in each bar. On each side of the casing is fixed a leaf of parchment paper, kept in place by slender strings. Thus, when the molasses is allowed to enter at the lower part of the casing, it rises in a serpentine manner through the five compartments to the top of the casing whence it may flow out.

A second casing exactly similar for the water, is joined to the first in such a manner that one leaf of parchment paper serves to separate the two cases. This pair constitutes what may be called a set or couple of osmogenes, but as one couple would allow of the treatment of only a small quantity of molasses, a number of these double casings are united, say 25 for water and 25 for molasses, which work simultaneously. The result is of course according to number of cases employed, and it is the union of these cases which is called an osmogene. It is only requisite for success that all the cases of molasses and all the cases of water should fill and empty themselves simultaneously, as if only a single couple were being operated with; to effect this, the molasses enters at the bottom of one end of the series of cases, and a tube communicates with each, the water entering by the top filling simultaneously every water casing and flowing out at the bottom.

There is thus maintained a constant efflux of molasses and of water in the osmogene, the two liquids being all the time kept separate during their course by the membrane of parchment paper.

For the following example we are indebted to M. V. De Luynes, in *Le Monde*. The process was applied to the purification of some Prussian molasses, which contained, according to analysis, 50 per cent. of crystallizable sugar and 14 per cent. of salts. Six successive operations of the osmose process were performed, each of which reduced the density of the molasses from 40° to 30° Baumé, and thus necessitated a fresh concentration after each operation to bring back the

density to 40°, so that the process might be carried out in identical conditions throughout, so as to render the effects comparable. The following results were obtained by the analyses of the six waters, by each of which the 100 grammes of molasses had been treated.

	Sugar.	Salts.
1st Water................	0·5	4·0
2nd ,, ...	0·5	2·0
3rd ,, ...	0·5	1·0
4th ,, ...	0·5	0·5
5th ,, ...	0·5	0·3
6th ,, ...	0·5	0·3

These figures with a slight correction, clearly indicate the law according to which the reaction is accomplished under the specific conditions; we see, in fact, that in proportion as the osmosed syrup is rich in sugar, the diffusibility of the sugar, which is slight, does not sensibly change; but this is conditional on constantly maintaining the density of the syrup. On the other side, we see that in consequence of the same property, the amount of salts diffused in the six successive operations decreases in geometrical proportion accordingly as the liquid treated is deprived of its very diffusive salts; and in the conditions of this experiment, for example, the diffusibility ceases to decrease at a certain limit, *i.e.*, when the quantity of the salts remaining in the syrup is reduced to six-fourteenths of the whole. The experiment also shows that although the molasses lost only 1 per cent. of its sugar during the first two operations, 6 per cent. of salts was removed.

OF BAUME'S AREOMETER.

By M. Baudin.

Sundry divergencies occur in Baumé's areometer, according to different authors. Upon examining this instrument, I found the figure given for 85 parts of distilled water and 15 parts of pure and well-dried chloride of sodium to be 1·111 absolute density at 15° C. Francœur found 1·109; Soubeiran, 1,116; Terlach, 1·114;

and M. Coulier, Professor of Chemistry, gives 1·110725. The work of the latter may be considered as the most important of those upon the subject.

Repeated experiments have convinced me that the figure of density 1·111 is most correct; I have, therefore, employed it to re-construct the actual scale of Baumé. The figure 1·116, given by Soubeiran, does not correspond with Baumé's formula (85 parts of water and 15 of salt), and indicates that the instrument marks 66° in a sulphuric acid whose point of concentration is undefined: this arbitrary scale is by no means that of Baumé. Serious results arise from these discrepancies—manufacturers are uncertain as to which Baumé-areometer they should trust, and endless disputes ensue. Brisson's densimeter should be the only one employed, as anyone can manage it.

Comparison of Baume's Scale (Acidimetric) with the Scale of Density.

Baumé. Degrees.	Francœur. Density.	Baudin. Density.	Soubeiran. Density.
0	1000	1000·0	1000
5	1034	1034·4	1036
10	1070	1071·3	1075
15	1109	1111·0	1116
20	1151	1153·8	1161
25	1196	1200·0	1210
30	1245	1249·9	1262
35	1299	1304·2	1320
40	1357	1363·5	1383
45	1420	1420·4	1453
50	1490	1500·0	1530
55	1567	1578·9	1615
60	1652	1666·6	1711
65	1747	1764·6	1819
70	1853	1875·0	1942

Correspondence.

CANE CULTIVATION.

To the Editor of "The Sugar Cane."

Sir,

"*The Sugar Cane,*" while abounding in scientific or technical contributions, especially as to manufactured sugar, is almost entirely bare of such practical matter as is adapted to the minds of unscientific readers; and as this serial is now obtaining a very extensive circulation, to render it proportionately useful it should, in a greater measure than hitherto, contain practical information on those modes of cultivating the cane which are at present pursued with the greatest success.

Some of the West India islands, from causes more or less incidental to them, are far in advance of others in their methods of cultivation, obtaining from a limited area of land of average fertility a much larger return of sugar per acre than had been obtained for a number of years previous to the introduction of new principles, or than *is* obtained from land of a superior quality in other islands.

The growth of these improvements has been very slow even in the more advanced of these islands; they arose in a great measure from a succession of dry years in the "Fortys," on the densely inhabited island of Barbadoes, and were initiated to some extent underthe influence of the writings and practice of P. L. Philips, Esq., proprietor of Lambert's Estate, in that island.

The most prominent features of these improvements are as follows, and are to be regarded as following each other in the succession in which they are now mentioned:—

1. Covering the fields of young canes with the trash taken from the fields of canes just reaped.

2. Planting the canes *wide*, making an allowance ranging from 24 to 64 square feet to each cane plant, instead of 16 square feet, the former allowance, causing as a natural sequence:

3. The use of other implements than the hand hoe, as single mould plough, subsoil plough, and grubber or cultivator, cheapening labour thereby, and improving tillage.

4. Keeping the fields entirely free of weeds.

5. Applying the manure to land several weeks before planting.

The development of these principles gave such an impetus to cane agriculture that every acre of land that could be made available was forced into use, and the cost of cultivation was so cheapened that spare labour and means were devoted to further improvements, by

6. Moulding the land in every practicable way in its most novel form, being an introduction of the Flemish plan of trenching their fields at small intervals, and applying the mould therefrom equally on the intervening spaces.

7. Green dressing, *cum multis aliis*, of local importance.

8. Opening large wells or fissures in the earth, for drawing off superfluous water.

9. Making mould traps, for arresting the mould washed from fields during heavy rains.

10. Subsoil draining.

Many of the above improvements are not dreamt of in the philosophy of the planters of some of the islands, who are struggling like a lion in the net of difficulties, without the help of the mouse to extricate them.

There is, again, a subject which, as much as any other, requires to be explained to the planters generally, that is, *cane ash*. Now, it is said by chemists that if all the inorganic matter taken from a soil is restored, its power remains unimpaired. The cane ash contains all the inorganic matter of the cane; this is by some collected, and kept most carefully from wet, and applied to fields of young canes certainly in greater proportion than it is taken from them. But the result of the crops does not correspond to this theory, and planters generally become sceptical, many indifferent,

and some wholly neglect this (said to be) valuable pabulum for the cane.

A treatise on this head in the pages of "*The Sugar Cane*," from some of its scientific contributors, would be of great value. It may possibly be assigned, as a reason of the apparent absence of proper action in the ash, that it is not applied in a state necessary for assimilation by the cane plant, not applied in that form in which it was taken from it; then a pulverization of this ash, to an almost impalpable fineness, would in some measure meet this difficulty: but probably, if it was dissolved without injury to its fertilizing power previous to application, the difficulty might be met.

What, then, is the dissolvent? In what quantity should it be used? What is its marketable value?

Again, if there is no *proper* dissolvent power, what are the cheapest and most efficient means for pulverizing?

The heads of these subjects are merely given, without an attempt to elucidate their mode of application, of action, or of particular results; these heads, then, form a nucleus for disquisition, and are given here suggestively, in order that some competent person may be induced kindly to lend himself to the task of elaborating these subjects, under the conviction that he will be helping the progress of the cause of agriculture. If the progress of agriculture during the last ten or fifteen years in Barbadoes, St. Kitts, and St. Vincent could be fully shown in "*The Sugar Cane*," with its causes, *modus operandi*, and results, a considerable boon would be conferred on the agriculturists of other islands, who have had no opportunities of seeing the effects of an advanced system, and whose practice is well nigh as old and unchanged as the hills that surround them.

These and kindred subjects dealt with in "*The Sugar Cane*," in language as little technical as possible, would no doubt produce some of the results which this publication aims at, viz., an increase in the production of sugar, with the greatest possible ease and least possible cost.

Jamaica, 22nd Feb., 1870.

ESTIMATED CONSUMPTION OF SUGAR IN THE UNITED STATES, IN THOUSANDS OF TONS.

(From H. E. Loring & Co., of New York.)

	1869.	1868.	1867.	1866.
Cane sugar imported and produced in the Atlantic States	493	470	401	382
Ditto ditto Pacific States........	24	19	18	17
Sugar produced from molasses (Sorghum Syrup, &c.)........	33	32	27	19
Maple Sugar..................	24	23	22	25
	574	543	467	453

STOCKS OF RAW SUGAR IN THE CHIEF MARKETS OF THE WORLD, IN THOUSANDS OF TONS, TO JANUARY 31ST.

	1870.	1869.	1868.
United Kingdom........	93	119	109
France................	143	138	115
Holland	26	32	32
Zollverein	44	62	36
United States	77	27	9
Cuba	59	31	30
TOTAL........	442	409	331

CONSUMPTION IN EUROPE AND THE UNITED STATES, IN THOUSANDS OF TONS, FOR THE YEAR ENDING 31ST JANUARY.

	1870.	1869.	1868.
Europe	1319	1200	1174
United States (imported sugar)	424	431	370
	1743	1631	1544

SUGAR STATISTICS—GREAT BRITAIN.

To 19th Mar., 1870 and 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	8	1	2	1	12	15	8	2	1	4	15	17	10	1	1	3	14	35
British East India	12	3	..	..	15	11	2	..	..	..	2	6	4	1	..	..	5	4
Mauritius	5	..	..	2	7	8	4	..	3	3	10	12	2	..	5	1	8	10
Cuba	8	1	1	2	11	7	..	3	3	6	12	9	2	5	3	11	21	21
Porto Rico, &c. ..	1	1	..	1	3	2	..	1	..	..	2	1	1	2	..	1	4	4
Manilla, &c.	32	5	..	1	39	49	4	3	1	1	8	11	7	5	1	1	13	15
Brazil	..	6	1	2	10	16	..	8	2	4	14	14	..	9	2	4	15	15
Beetroot, &c.	3	1	..	4	8	6	9	3	2	10	24	16	8	4	2	10	24	35
Total, 1870 ..	69	19	4	12	104	115	28	20	12	27	88	86	35	26	13	31	105	113
Total, 1869 ..	71	29	4	11	11 decrease		36	16	13	22	2 increase		41	25	12	36	8 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

THE Sugar Market has continued very dull during the month especially for raw sugar, most of the refiners, both in London and on the Clyde, having closed their establishments, pending the uncertainty regarding the duty. There was a slight advance on crushed goods at one period, owing to their scarcity, but it has not been sustained.

The conviction gains ground that some alteration will be made in the sugar duties, but their entire abolition is not expected, as the reply of the Chancellor of the Exchequer to the last deputation on the subject conveyed a contrary impression.

In the present uncertainty and stagnation, the comparative deliveries are of less import than usual, but the decrease as compared with last year (8,000 tons up to March 19th) is not so great as might have been anticipated under the circumstances.

The latest advices from the various sugar producing colonies are, on the whole, favourable. The crop in Mauritius has been above an average, the quantity of sugar produced being 130,000 tons; of this the greater part (80,000 tons) had been exported before the middle of January, chiefly to the Indian and Australian markets. In Reunion, too, the crop has been larger than usual, and in consequence of the continuance of the drawback in France for a short time in favour of that island, the shipment of the crop will probably be hastened. In Java the yield does not prove equal to the anticipations that were formed of it, and the same may be said of the crops of Louisiana and Brazil. There is a fair prospect in the various West India Islands, and unless political causes should operate unfavourably, the supply from Cuba will probably be equal to that of last year.

It must be noted that the aggregate stocks in the chief markets to the end of January show a decided increase over the same period of 1869, and that the figures at which the Continental beet sugar crop is now set down exceed by 5000 tons the estimate formed a month ago; but if any material reduction should be made in the duties increased consumption will no doubt more than counterbalance this increase of stocks.

THE
SUGAR CANE.

REGISTERED FOR TRANSMISSION ABROAD.

No. 10. MAY 2, 1870. Vol. II.

For Table of Contents, see opposite the last page of each Number.

THE BUDGET.

Our readers in most parts of the world will be fully aware long before our present issue reaches them of the reduction in the sugar duties of the United Kingdom, which forms the principal feature in the Budget of 1870.

It is long since any Chancellor of the Exchquer had a surplus at his disposal of over four millions sterling, and very rarely has the disposal of it given such widespread and general satisfaction. A reduction of fifty per cent. on the sugar duties is not merely a boon to the English customer, but it will beneficially affect all branches of an industry to the magnitude of which we need not advert. No other article of Customs or Excise is so important to the people of this country and a similar reduction on any other would have been of little benefit to any of our colonies.

The producers of sugar in all parts will not only be benefitted by increased consumption in the British Isles acting favourably on markets, but the example of this country must eventually have considerable influence on Continental governments, many of whose Customs and Excise duties on sugar, at present unjustifiably high, check consumption, and drive much of their produce to the English market.

Though Mr. Lowe has not done all that we have wished and have advocated in these pages, total repeal of the sugar duties being the mark at which we have aimed, we must acknowledge that he has done quite as much as could reasonably be expected of him, or of any government of which he is a prominent member. His

announcement that the present change must be considered as final, not as a step to further reduction, is also in one sense satisfactory, as for many years past every branch of the sugar trade has suffered for months before the annual financial statement, from the anticipation of fiscal changes, whereas the question may now be considered as settled for some time to come.

We scarcely suppose that the advocates of an equalization of the duties expected to carry their point either wholly or in part, as doubtless they have been aware of what Mr. Lowe reminded the House of Commons, that the country is under treaty not to disturb the relative proportions of the scale; but it will be a source of satisfaction to them that the actual difference between the duties on different classes of sugar is only half what it was, so that those accidental inequalities in the assessment of sugars by the Customs' authorities which sometimes occurred will be of less importance than formerly, now that the duties on sugars from the lowest jaggery to the finest loaf do not vary more than 2s. per cwt.

No doubt this important reduction in the British sugar duties will tend to the increased prosperity of our colonial sugar planters, more especially in the West Indies, where we hope that the attention now being paid to local burdens will result in a large economy in many items of their expenditure and in the entire abolition of the export duties on produce levied in several of the islands. These are matters within their own control, in which the home government can do but little; what influence the Colonial office possesses will we are persuaded be exercised in the right direction.

As likely to be of permanent interest and useful for reference we append the resolutions relating to the sugar duties submitted to the House of Commons on the 11th April, and which appeared in the parliamentary votes of the day following:—

1. Resolved,—That, towards raising the supply granted to Her Majesty, on and after the under-mentioned dates, in lieu of the duties of Customs now charged on the articles under-mentioned, the following duties of Customs shall be charged thereon, on importation into Great Britain or Ireland, viz.:—On and after the 2nd May, 1870, sugar, viz.: Candy, brown or white, refined sugar,

or sugar rendered by any process equal in quality thereto, and manufactures of refined sugar, 6s. per cwt. On and after the 13th April, 1870—sugar not equal to refined :—First class, 5s. 8d. per cwt. ; second class, 5s. 3d. ; third class, 4s. 9d. ; fourth class (including cane juice), 4s. ; molasses, 1s. 9d. ; paste of almonds, 4s. 8d. ; dried cherries, 4s. 8d. ; dry comfits, 4s. 8d. ; confectionery not otherwise enumerated, 4s. 8d. ; preserved ginger, 4s. 8d. ; marmalade, 4s. 8d. ; succades (including all fruits and vegetables preserved in sugar, not otherwise enumerated), 4s. 8d. ; and that the said duties shall be paid on the weights ascertained at landing.

2. Resolved,—That, on and after the under-mentioned dates, in lieu of the drawbacks now allowed thereon, the following drawbacks shall be paid and allowed on the under-mentioned descriptions of sugar refined in Great Britain or Ireland on the exportation thereof to foreign parts, or on removal to the Isle of Man for consumption there, or on deposit in any approved warehouse, upon such terms and subject to such regulations as the Commissioners of Customs may direct for delivery from such warehouse as ship's stores only, or for the purpose of sweetening British spirits in bond (that is to say) :—

On and after the 2nd of May, one thousand eight hundred and seventy :—

	£.	s.	d.
Upon refined sugar in loaf complete and whole, or lumps duly refined, having been perfectly clarified and thoroughly dried in the stove, and being of an uniform whiteness throughout; and upon such sugar pounded, crushed, or broken in a warehouse approved by the Commissioners of Customs, such sugar having been there first inspected by the officers of customs in lumps or loaves as if for immediate shipment, and then packed for exportation in the presence of such officers, and at the expense of the exporter; and upon candy (for every cwt.)	0	6	0
Upon refined sugar unstoved, pounded, crushed or broken, and not in any way inferior to the export standard sample No. 2, approved by the Lords of the			

Treasury, and which shall not contain more than 5 per centum of moisture over and above what the same would contain if thoroughly dried in the stove.	0	5	9
And on after the 13th day of April, 1870 :—			
Upon sugar refined by the centrifugal or by any other process, and not in any way inferior to the export standard sample No. 1, approved by the Lords of the Treasury (for every cwt.)	0	6	0
Upon other refined sugar unstoved, being bastards or pieces, ground, powdered, or crushed:—			
Not in any way inferior to the export standard sample No. 3, approved by the Lords of the Treasury	0	5	8
Not in any way inferior to the export standard sample No. 4, approved by the Lords of the Treasury	0	5	3
Not in any way inferior to the export standard sample No. 5, approved by the Lords of the Treasury	0	4	9
Inferior to the above last-mentioned standard sample	0	4	0

3. Resolved,—That, in lieu of the duties of excise now chargeable on sugars made in the United Kingdom, the following duties of excise shall be charged thereon, that is to say, on and after the 2nd day of May, 1870, candy, brown or white, refined sugar, or sugar rendered by any process equal in quality thereto, and manufactures of refined sugar (the cwt.) 6s. On and after the 13th day of April, 1870, sugar not equal to refined:—First class (the cwt.), 5s. 8d.; second class, 5s. 3d.; third class, 4s. 9d.; fourth class, 4s.; and molasses, 1s. 9d.

4. Resolved,—That on and after the 13th day of April, 1870, in lieu of the duties of excise now chargeable upon sugar used in brewing, there shall be charged and paid upon every hundredweight, and in proportion for any fractional part of a hundredweight, of all sugars which shall be used by any brewer of beer for sale in the brewing or making of beer, the excise duty of 7s. 6d.

PRACTICAL OBSERVATIONS ON CANE MANURE—No. III.

By Dr. T. L. Phipson, F.C.S., London.

Member of the Chemical Society of Paris.

Anyone who will take the trouble of perusing the accounts of the old experiments made by Giobert, Lampadius, and especially by Hassenfratz, De Saussure, and Einhof, will soon be convinced that very little practical knowledge has been gained by the more recent researches of Davy, Boussingault, Mulder, Liebig, and others, as far as the direct action of manures is concerned, and that very few facts of practical importance have been added to what was perfectly well known prior to the year 1820. We fancy that we have made advances in theory—let us hope it is true!

Giobert mixed together the four substances silica, magnesia, alumina, and lime, in the proper proportions, as he thought, to constitute a fertile soil; he planted vegetables therein and watered them. But none of them grew until he moistened his artificial soil *with water from a dunghill.* Lampadius varied the experiment by forming several compartments, which he filled each with a different substance: silica in one, alumina in another, limestone in a third, and so on. The plants which he caused to grow in these extraordinary soils "did so because he watered them with the liquor which exuded from a dunghill."

These are some of the oldest experiments on manures, and were made as we see, with the most perfect manure yet known, stable manure. But centuries before this the natives of Peru used guano, and the manner in which nightsoil came to be known as a most active fertilizer, is so lost in the mist of byegone ages that we can only conjecture with Loudon, that man found it necessary to bury it in the earth in order to avoid its disagreeable odour, and immediately observed its effects on vegetation.

Farm-yard manure is still the most perfect fertilizer known, and all our artificial manures are merely auxiliaries; I will allude further on to a manure made from excreta, which is the only one that can be compared to it.

One fact of considerable practical importance, has indeed come to light within the last 50 years: it has been found that taking it for granted that all the substances mentioned in my last paper are absolutely necessary, in some form or other, for the perfect development of a plant (especially a *cultivated* plant which is required to yield its utmost amount of product) it has been found, I repeat, that of all these phosphoric acid is the most likely to be deficient in any given soil. This is more especially the case in thickly populated and highly civilized districts. The solid structure of the body in which phosphate of lime figures largely, is solely derived, as everyone knows, from the soil by means of the plant. Thus in London with its three millions of inhabitants, or thereabouts, we have considerably more than 60,000,000 lbs. of phosphate of lime (more than sufficient to manure 300,000 acres of land per annum) walking about in the streets, besides that which accumulates year after year in certain places provided for the purpose (churchyards and cemeteries) where it will remain for centuries before returning to the arable lands whence it was originally derived. At the same time a constant flow of phosphates of lime, magnesia, and ammonia issues from all our houses, railway stations, and other public buildings, finding its way in the liquid form to the sewers and disappearing for centuries, perhaps for ever, as far as any direct agricultural application is concerned.

The same form of argument applies scarcely less forcibly to nitrogen which is annually wasted to an incredible amount, though it is less likely to be often deficient in a soil than phosphoric acid.

As regards graminaceous plants and the sugar cane in particular, the principles next in importance appear to be lime, potash, silica, sulphuric acid, and magnesia. Potash is perhaps more frequently present in soils in general than lime, since it is constantly derived from the weathering of granite rocks and feldspars, which also yield silica in the soluble form to all clays. This action is continually going on in nature, yielding potash, soda, and silica, to a very large amount.

It was thought formerly that the surface of the earth was infinitely fertile and that it might be robbed with impunity to any

extent, every one took from it as much as possible and returned to it, in the shape of manure, as little as possible. Thus it was that the granaries of Rome, Sicily and Spain were emptied and never re-filled. Certain soils in America, said to be inexhaustible, have been exhausted in less than half a century! (tobacco, &c.)

The idea of rendering phosphoric acid more available by partially dissolving the various kinds of phosphate of lime in sulphuric acid does not appear to be based upon very sound scientific principles. The manure termed "superphosphate" which is thus produced, has been found, as we have already seen, more especially advantageous to turnips and plants of that family, probably because these plants not only benefit largely by phosphates, but take up large quantities of sulphur, (this was fortunate, otherwise the superphosphate manures might have proved a failure!) We have numerous experiments on the direct results of superphosphate applied to graminaceous plants and turnips. The crops of the former do not seem to benefit at all by it, whilst the latter are notably increased.*

We said that dissolving phosphates in sulphuric acid is not based, perhaps, upon sound philosophy; may be, it implies some ignorance of the methods by which the roots of plants absorb their insoluble mineral nourishment. It appears tolerably well proved, that this is effected by the secretion of some vegetable acid, and was well shown by the plates of marble exhibited in the Austrian department of the last French Exhibition, where the rootlets of wheat, maize, &c., had left their traces eaten into the marble; and also by M. Cloez's experiments, in which, he caused grains to germinate on blue litmus paper, the course of the rootlets being well marked by permanent red streaks, which did not disappear on drying and were, therefore, not caused by carbonic acid.

Lastly, it is proved by the fact, that the most insoluble of mineral phosphates (such as coprolites,) reduced to powder and strewn upon soils deficient in phosphates, increase the yield of the fields

(*) See Professor John's researches: *Journal für Praktische Chemie,* vol. L, page 57. These experiments were made in 1843 to 1845; also, Lawes and Gilbert, *Experiments on the growth of Wheat,* London, 1864.

at once, whilst, if they are applied upon soils which contain a due proportion of phosphates, no increase of the crops occurs.*

The latter fact points to the importance of knowing something about the natural resources of a soil, from which crops of any kind are regularly raised. There are, indeed, in England and in the north of France, wide districts where phosphates may be strewn in any form, year after year, with no effects whatever upon crops of any kind. But, as regards a plant of so exhaustive a nature as the sugar cane, it may be set down as a general rule that the application of manures, even, to soils of the most favourable nature, will always repay the outlay, provided such manures contain in an assimilable form the substances to which we drew attention in our last paper. We have seen that the sugar cane takes up a considerable quantity of phosphoric acid, lime, potash, silica, &c., and we already know by direct experiments, that abundance of nitrogen is absolutely indispensable to all cultivated plants of this family. Therefore, any manure which is devoid of these principles is of course an imperfect manure, as regards cane, and can only supply it with some of the materials it requires, whilst, the others must still be derived from the soil.

In the case of a soil such as that from Demerara already alluded to, and *a fortiori* such as are still more exhausted, it is necessary to turn our attention to the substances it requires most, and to supply them rather in excess, in a good compound manure.

Though we have very few direct scientific experiments on the culture of sugar cane in the West Indies, we possess, on the other hand, a considerable number of results obtained in Europe upon wheat and oats, which are plants of the same family, and also upon beet-root which is cultivated for the same product (cane sugar), and I concur in great measure to what is stated by a Jamaica correspondent, in the *Sugar Cane* magazine, No. 9, whose letter is dated 22nd February, and who, consequently could not have seen what I had written in No. 8. An important fact is also

(*) See P. P. Dehérain, *Annuaire Scientifique*, Paris, 1868, and the article *Engrais*, in Wurtz, *Dict. de Chim*, (8 ième fascicule, p. 1229, *et. seq.*) Paris, 1869.

alluded to in the same No. (No. 9, April, 1870,) by Mr. Krajenbrink, who speaks of cane soils in Java, losing their humus, or organic matter quickly, and becoming sterile. It is commonly held that soils of hot climates, especially tropical climates, contain more organic matter than those of our latitudes. But, judging from my own experience, this does not appear to be the case, and is certainly not so, for cane soils. The loss of organic matter may, indeed, prove an important source of sterility, by causing a want of porosity, and of nitrogen and carbonic acid. In my next paper I must endeavour to show what may be termed a perfect manure, as regards cultivated plants in general and sugar cane in particular, and how an artifical manure should be manufactured to suit cane soils, whether they be partially exhausted or not.

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IRRIGATION.

EXTRACT FROM THE REPORT OF THE COMMISSION OF THE CHAMBER OF AGRICULTURE OF THE ISLAND OF REUNION, ON IRRIGATION APPLIED TO COLONIAL AGRICULTURE.

(From the French.)

THE theory of irrigation is intimately connected with that of drainage; because, if the proper distribution of water to the soil is an essential element for developing vegetation, its remaining there too long, its stagnation, becomes hurtful to the plant, and may cause its destruction; but the soil of our island is found to be drained naturally by reason of its physical formation and inclination. We may therefore leave this second part of the question, and give our attention to the first.

The circulation of water in cultivated soils not only contributes to the activity of vegetation by the access of humidity, but also to their fertility, and in the long run improves them. *"The division of the soil into particles between which the air can circulate, and the pores of which may imbibe both air and water,

* Barral, Theorie du Drainage et de l'Irrigation.

such is the essential condition for the accomplishment of the phenomena of vegetation, and it may be added that the nourishment of the plant is prepared by the reaction of the oxygen of the air on the organic matters of the earth. In the chemical effects which may be produced by drainage and irrigation, the air acts on the various substances contained in the soil, and especially its oxygen combining with the organic matters, produces carbonic acid, and in consequence disintegrates and dissolves the calcarious substances, decomposes the phosphates, peroxide of iron, &c. &c., and, as a necessary consequence, the earth crumbles and acquires the porosity needful for vegetation. When fresh rains fall unexpectedly, or irrigation is practised, the water drives out the air previously introduced, modified air having lost its oxygen, which consequently is renewed, to the great benefit of vegetation. In short, water has the property of dissolving the two chief elements of the atmosphere, oxygen and nitrogen, but because there is more oxygen to be dissolved than nitrogen, this oxygen produces an eminently useful effect on vegetation. Fact is here in accord with theory." The properties of the water also exercise a great influence on vegetation.

"Water contains always in solution in its mineral state oxygen, carbonic acid, ammonia, nitric acid, organic compounds, and mineral salts, which exercise an energetic action on vegetation, and furnish plants with the food which they require."*

Wishing to report of the composition of the waters of our river, which are generally used for irrigation, we have submitted to analysis some of the sedimentary deposit from the river Pluies, collected in our steam boilers, with the following result:—

A noticeable quantity of carbonic acid combined with lime and magnesia, a considerable proportion of iron, of silica, and of alumina and soda.

In short, the deposit analyzed may be represented by the following bodies:—silica, alumina, lime, magnesia, soda, iron, chloride, carbonic acid, oxygen, and hydrogen.

The small quantity of deposit submitted to the chemist did not

* Herve Mangon, "Encyclopedie de l'Agriculteur."

permit of the determination of the proportions of each; but, according to the reactions observed, lime, iron, and magnesia entered largely into its composition.

This analysis, it may be said, represents very nearly the composition of the waters of all our rivers, as they take their rise in a common centre. The presence of lime is especially valuable for our low lands, which contain little or none. Irrigation then may enrich lands with substances in which they are deficient. This last consideration, and others above mentioned, will then explain how in certain localities of our island the lands submitted to irrigation have been cultivated for years without fallowing, always giving excellent crops, without losing their fertility in any appreciable degree.

We have now to treat the practical part of the question :—

1. Sources of the supply of water and the different means of procuring it.

2. The volume of water needful for the irrigation of a given superficial area.

3. The necessary preliminary survey of the parts which it is wished to irrigate.

4. The works for the distribution of the water.

SOURCES OF THE SUPPLY WATER, &c.

The water which is to be used for irrigation, may be obtained from natural sources, rivers, brooks, and ravines, or artificially from wells.

But little water flows in our rivers, generally, after the period of the great rains of winter. In the dry season, the time when irrigation is most needed, the supply of water fails and the beds of our torrents become completely dried up. But under the permeable sand and pebbles, of which the river beds are composed, there often flow streams of water of considerable volume, which are never exhausted. Not penetrating the lower strata, the water filters gradually, and goes silently to the coast into the waves of the sea. These waters might be utilized, by opening trenches in the mass of sand and gravel in the most favourable parts of our rivers, to their

full breadth, and by filling up these trenches with impermeable puddling from the solid bottom: the waters, unable any longer to escape, would rise to the surface, and might be turned into canals. The puddling in question might, according to the importance of the work, be made with clay mixed with pebbles and carefully stamped down; or with hydraulic concrete, composed of the volcanic ashes and lime which the country furnishes in abundance. The above applies chiefly to the brooks and ravines, which are real torrents in the rainy season, but the beds of which are quite dry in summer.

There is another method of increasing the volume of water wasted during the low water of our rivers. It consists in establishing large dams in the most narrow and embanked parts of their beds, thus forming immense reservoirs, which store up for use during the dry season the superabundance of water which falls during the rainy season. But these immense works raise the grand problem which should be previously solved, and which is beyond our province (that of their cost.) Meanwhile, because of its importance, your commission expresses the opinion that this question should be brought before the notice of the government.

Springs of water may also be a precious addition to the supply for irrigating purposes. We do not mean merely springs which rise above the surface of the ground, but those which may readily be brought to light by works easily executed.

Waters which rarely appear above the surface, may be found in abundance under our feet. It is sufficient to glance at the configuration of our island, to have an idea of the quantity of water which might be obtained and stored in reservoirs. Unfortunately, the waters rapidly penetrate the permeable surface of our soil, following at variable depths the lower beds, and flow like the waters of our rivers unseen to the sea coast, without having been utilized to the profit of our agriculture.

With an attentive study of our lands, and the peculiarities of our ravines, by practising the boring which the new system of tubular pumps renders feasible, it is possible to find out the locality of subterranean sheets of water, and by opening trenches perpen-

dicular to the slopes, until the veins of water are met with, it would be easy to conduct it to the surface.

In many localities of our island, especially on the lowland plains near the coast, sheets of water are met with at very slight depths, a few yards at most. Wells dug at slight expense, with barrels within them, would supply great volumes of water, which might be raised by horse power, by windmills, or still better, by powerful steam engines.

On the Volume of Water Necessary for the Irrigation of a given Superficial Area.

The quantity of water required for watering any area must necessarily vary according to the climate, the nature or the composition of the soil, and lastly, the crops submitted to irrigation.

It will be impossible, therefore, to give any absolute rule. The method of carrying it out is also sensibly influenced by the quantity of water absorbed by each watering; we speak, therefore, with these reservations, adopting for all our crops the system of irrigation by overfall *(deversement)*. We should say that the volume of water required for the irrigation of the sugar cane varies between one and three litres per second for each hectare (from half a gallon to a gallon and a half per second per acre). Within these limits we shall admit, that for the usual wants of this country, that a current of about a gallon of water per second per 1000 rods, say a cubic foot of water for every 10,000 rods is needed. In these conditions, the plantations may be watered every fortnight (the water running as long as circumstances may require).

In dry localities, when the volume of water at disposal is insufficient, it may be advantageous only to consider irrigation as a means of preserving the plant without stimulating its growth. In this case it may be watered more seldom, or the same quantity of water made to serve for a greater area. When summer rains come, plantations thus watered will make rapid progress, and give satisfactory results.

The Preliminary Survey of the Ground.

When sufficient volume of water is available, it is needful then carefully to survey the lands which it is intended to irrigate. This

is very important; it is needful so to manage the water as to have it accessible at all points, to take it by the shortest course, to facilitate its flow as much as possible, to avoid inequalities in the soil, in short, so to direct the work as to render its execution as easy and economical as possible.

In extensive estates, of which the surface presents great declivities, this survey requires to be very complete, and professional assistance is generally requisite. In this part of our island where we write, the natural inclinations of the soil render the survey very easy. A few directions will enable our agriculturists to plan for themselves means of irrigating their plantations.

The surface to be irrigated will determine the line of the principal supply canal. It will next be seen whether, on the high lands, there are hillocks in front of the valleys, which prevent the direct course of the water. These must be levelled by means of terraces or banks; if they are not of great elevation, terraces will be sufficient, and the water-course will only need *puddling*; otherwise, sloping banks of rough stone must be made, and on this a water-course prepared with concrete at the bottom and sides. This work is of great durability and once made, seldom needs repair. In cases of emergency, wooden aqueducts may be made, supported by simple posts well embedded in the soil.

Contrivances for the Distribution of the Water.

After these preliminary works, the manner of distributing the water must be planned. The principal supply canal, when the water is obtained from a river or watercourse, should, at its commencement, be constructed of solid masonry, with locks of hewn stone, provided with groves for sluices, to shut off the water in case of floods. The canal itself may be made at an incline of one in five hundred.

In cases of unusual difficulty choice may be made between stone aqueducts, iron syphons, tubular bridges, &c., according to circumstances, in these cases professional advice should be taken.

The mode of construction of the supply canal, and the materials of its composition, vary according to the land to be traversed. In argilaceous subsoils a simple dyke will suffice, care should be taken

then to give to the sides of the canal sufficient inclination, and to turf the upper parts to prevent their falling in. The slope of the sides will need to be greater where the land is of a looser nature. The lower bank of the canal should be constructed so as to afford convenient means of inspection and repair. In sandy or stony soil, where the subsoil is permeable, more expensive works must be constructed, to avoid loss of water by infiltration.

In general, strata of volcanic origin, such as the soil of our island, contain numerous fissures, by which the water escapes unperceived. Whenever a rocky soil is met with, or one formed of soft sand stone, mixed with portions more or less hard, it will be needful to make the bottom and sides of the canal with concrete; ordinary stone work, such as native workmen construct, allows, after a time large quantities of water to filter through, it then becomes necessary to take out the mortar from between the stones and fill up the spaces with concrete. When the concrete is well made it acquires in time the solidity and durability of stone.

When the supply canal is to be constructed on an incline of difficult access, we do not hesitate to advise the use of iron. Canals of this kind are made at moderate prices, the thickness of the metal varying from ⅛ to ¼ of an inch according to the capacity of the canal. The stability required may be ensured by corner pieces. These canals last a long time if preserved now and then with a coat of paint or tar. In the case in point they are less expense than masonry. The chief supply canal should traverse the ground to be irrigated through its whole extent; for distributing the water several kinds of conduits are needful—1st, those which receive the water from the supply canals and conduct it to—2nd, the trenches which empty the water into furrows; and whence, lastly, it is distributed over the fields to be irrigated. * * * *

The trenches and the furrows which distribute the water should both be so constructed as to carry the waste water off outside the fields by which excess of water in irrigating will be prevented and also during the rainy season the water not absorbed by the soil will be carried off without doing any damage.

The trenches and furrows must be proportioned to the quantity

of water they are to carry, and in the former, when the inclination is considerable, sills should be placed here and there to retain the soil which is carried down by the flow of the water.

The preservation of the furrows will need many precautions, their level should be maintained with great care to ensure the regular flow of the water; their depth should not exceed 8 or 9 inches (half that depth cut and the earth banked up) and the width across the top about 15 inches. * * * * * *

In conclusion what we have said on the advantages of irrigation applied to our agriculture will merely confirm the opinions you have already formed on the ability it confers of planting and obtaining crops at the most favourable periods, of carrying into the soil at any time the manures which may be needed, and lastly of the great economy of manual labour which it enables us to exercise in our agriculture.

As an immediate consequence of irrigation the return of our crops will be increased, but this increase does not permit of actual estimate. It will naturally vary with the differences of the climate, soil and mode of culture. If in dry regions where for want of water the growth of crops is ordinarily impossible, all the produce of the soil may be attributed to irrigation, we may also say that its application will not be without influence even in humid localities. As we have already explained periodical watering not only favours vegetation by furnishing the plant with the requisite degree of moisture, it also acts chemically on the soil by carrying to it new principles and favouring the transformation of its constituent elements. Lastly it is worthy of remark that those localities of our island submitted to irrigation have been able to struggle with advantage against all the scourges of which the influence has been so fatal to our colonial agriculture.

Better days appear to be in store for our country so hardly tried, but we must not forget that our soil has lost its pristine fertility; let us then seek to repair the fault of our shortsightedness. It is by obedience to the great law of restitution, by improving our system of culture, in a word by putting in practise the lessons of science and experience that we shall be able to regain our lost prosperity.

ON THE PART WHICH SALTS AND UNCRYSTALLIZABLE SUGAR HAVE IN THE FORMATION OF MOLASSES.

By M. Eug. Feltz.

The determination of the salts is now generally practised in the analyzation of raw sugar, and has had considerable effect in leading to the conclusion that the mineral salts, such as the chlorides and the nitrates, are the principal causes of the production of molasses. In these latter times refiners have thought well to place uncrystallizable sugar amongst the number of noxious impurities, and have dignified this substance with a co-efficient which, although it is less than the saline co-efficient, has not the less provoked the complaints of the beet planters. As, sooner or later, chemical analysis will reach such perfection as to admit of determining separately the exact diverse substances which combine with the sugar in the molasses, these planters anticipate the time when, thanks to the co-efficients with which each of these constituents will be endowed, the refiners will absolutely refuse to pay for inferior sugars. It may not then be without its use to examine the part which is played by salts and uncrystallizable sugars in the formation of molasses, and to determine up to what point we should take them into account in the estimation of the yield, according to the analysis now in use.

The saline co-efficient being purely arbitrary, we have no right to conclude, from the satisfactory accordance of its indications with actual results, that the salts, still less the mineral salts, are the only producers of molasses.

Dr. Scheibler has made a series of very interesting experiments on this subject, of which the results have greatly excited the French chemists. M. Scheibler has, in fact, arrived at the conclusion that not only the saline crystallizable constituents do not contribute to the formation of molasses, but that certain salts exercise a contrary influence, and even favour the crystallization of sugar to a small extent. In order to study the action of salts on sugar, M. Scheibler has ascertained the dissolving power of divers saline solutions on pure sugar. If these salts are the means

of producing molasses, says M. Scheibler, saline solutions ought to dissolve more sugar than distilled water in the same conditions. These experiments, made at first at the ordinary temperature of 58° to 60° Faht., were afterwards carried on at a higher temperature. M. Scheibler's conclusions have not been modified by these new experiments, and he thus summarizes his opinion on the formation of molasses:—*Substances capable of crystallization do not contribute to the formation of molasses, which must be exclusively attributed to the uncrystallizable substances contained in the juices or syrups.*

M. Stammer, in an article on the application of osmose to molasses, enters at length into the consideration of the same subject. The conclusions of the work of M. Scheibler had provoked a rather warm reply from M. Dubrunfaut, in which this *savant* reproaches the German chemists with misunderstanding the hurtful influence of salts. M. Stammer explains what he means by the too elastic word "salts," and says that it is very probable the true salts of molasses, that is to say, the combinations which we find unaltered in the ash, do not exercise so great an influence on sugars as is generally admitted. He has arrived at this conclusion through some unpublished experiments made with mixtures of pure sugar and the ash of molasses. He has proved thereby that *the crystallization of sugar is not prevented by the inorganic salts of the ashes of molasses, added even in much more considerable proportions than those given by the analysis of molasses.*

We owe to M. Anthon a very complete series of experiments. The *Journal des Fabricants de Sucre* has published his work on the subject. This chemist has proved that whenever in any syrup sugar is found in quantity more than double the weight of the water, the sugar will crystallize, whatever may be the mineral salts added to the sugar. If, on the contrary, we dissolve by the influence of heat an excess of salt, this excess will be precipitated on the return to the normal temperature. If the solution is supersaturated with sugar and salt at the same time, the two substances will crystallize successively or simultaneously. Thus, for example, some Hungarian raw sugar containing 22·5 per cent. of saltpetre has been crystallized from its molasses.

M. Anthon does not conclude from these experiments that the salts have no action whatever in the formation of molasses: he gives another reason for the pernicious action of these substances. He admits that a salt retains sugar in a molasses in proportion as it is difficult of solution in water. Thus, for example, 4 parts of chloride of calcium require 6 parts of water, but these 6 parts of water would dissolve 12 parts of sugar. It follows, then, that 4 parts of chloride of calcium retain 12 parts of sugar, and thus the co-efficient 3 is given to this salt. These conclusions, as M. Scheibler remarked on the publication of M. Authon's *mémoire*, are erroneous. Besides, M. Anthon himself observes that the co-efficient of the mass of salts in a molasses should not be based on these considerations. He concludes finally that the valuation of the yield of raw sugar can only be arrived at exactly by taking account of all its impurities, organic and inorganic.

We thus see that the German chemists have greatly shaken the basis of the saline method. Their experiments are precise, and it is easy to verify them.

M. Payen has endeavoured to explain the divergence of opinion which separates M. Dubrunfaut and the German chemists on the important question of the influence of salts. According to him, saltpetre does not prevent the crystallization of sugar, but the chloride of potassium retards the crystallization, and the chloride of sodium retains six times its weight of sugar. Two analogous cases may present themselves in the actual industry. We have seen that raw sugars will crystallize in the presence of saltpetre, but we know that beets cultivated on the sea coast have given so feeble a return of sugar that the manufacture of sugar from them was abandoned. The first case accounts for the results arrived at by M. Scheibler, whilst the pernicious influences of salt are proved by the second. "These exceptional conditions ought not weaken," says M. Payen, "the results of numerous analyses from which M. Dubrunfaut has deduced the general average which serves as a guide to complete saccharimetry, by the co-efficient 3·73 of salts contained in raw sugars."

M. Dubrunfaut, on his part, has made some experiments on

mixtures of pure sugar and salts. He has also proved that chloride of sodium and sugar may be able to crystallize simultaneously or successively from a solution which contains both in a state of supersaturation. The same result was presented with saltpetre. M. Dubrunfaut concludes from these trials that synthetical experiments made with pure sugar and mineral salts cannot lead to any decisive result on this important question. He relies, meanwhile, on these experiments to explain the curious anomalies he has met with in the examination of divers molasses.

Thus, according to M. Dubrunfaut and M. Payen, the salts play an important part in the formation of molasses, and, as we know, the osmose process is directed almost exclusively to the elimination of the alkaline chlorides and nitrates.

The discussion of the results obtained in the manufactory with reference to this question lead to the same uncertainty as the examination of the opinions of the different chemists. The variableness of the saline coefficient with the nature of the molasses, the actual crystallization of saltpetre with sugar, is completely inexplicable, if we assign to salts any important part in the formation of molasses. The industrial results of the osmose process, the crystallization proved to follow the osmotic purification, appear, on the contrary, to assign to the mineral salts a very important part.

In the presence of opinions so divergent, founded on some real facts easily verified, it has seemed interesting to repeat the experiments in a little different form, by endeavouring to approach nearer to the conditions of actual manufacture. The important question of the uncrystallizable, recently called forth on the platform of discussion, has decided us to publish the results at which we have already arrived before we finish all the experiments we have undertaken on the subject.

The artificial syrups prepared for these experiments were boiled in vacuum, a double-necked flask constituted the boiling apparatus, in one of the necks was placed a thermometer, and a curved tube serving for supply by suction. In the other was placed the central tube of a Gay-Lussac condenser or refrigerator.

The vapour produced in the flask was condensed in this tube,

and the condensed water conducted into a graduated guage, hermetically closed and placed in communication with the vacuum pipe of the factory. A tap conveniently placed served to regulate the pressure, and a mercurial guage indicated the vacuum.

For these experiments a syrup of 50 per cent. of sugar was used, *i. e.*, containing equal weights of sugar and of water. In this proportion the sugar is easily dissolved, and the syrup is sufficiently concentrated to keep for some days without change.

1*st Experiment.*—Boiling of a syrup containing five parts of sugar to one part of chloride of sodium. Composition of syrup:—

	Per Cent.
Refined sugar	45·27
Water	45·46
Salt	9·14

135·4 grammes of this syrup were evaporated under a pressure of 21 inches; when 35 grammes of water had been condensed from it, numbers of crystals of chloride of sodium were observed in the flask; 59·5 grammes of syrup of the same composition were then pumped into the flask, when the crystals disappeared, re-appearing when 49·0 grammes had been evaporated. 69·5 grammes of the saline syrup were then added, and evaporation continued until the crystals re-appeared again; 10 grammes of syrup (50 per cent.) were then added to dissolve the crystals Concentration and adding to the flask was continued in this way until it was possible to concentrate to a strong proof without the appearance of crystals of salt; 192 grammes of the pure sugar solution were thus added, and 171 grammes of water altogether evaporated. The contents of the mass remaining in the flask were then:—

	Grammes.
Sugar	215·7
Water	45·1
Salt	24·5

This mass, on cooling, should give up:—

		Grammes.
Sugar	$215{\cdot}7 - (2 \times 45{\cdot}7) =$	125
Salt	$24{\cdot}5 - ({\cdot}345 \times 45{\cdot}1) =$	9

There was no crystallization on cooling, but, placed in a stove, a large quantity of sugar was produced in about 24 hours; the mother water, separated from the crystals, gave upon stoving a further quantity of sugar, without it being possible to detect by the microscope a single crystal of chloride of sodium. If the salt had prevented the crystallization of six times its weight, as is generally admitted, there would have been no crystallization of sugar at all.

2nd Experiment.—Syrup containing saltpetre.

Ten grammes of saltpetre were thrown into the flask containing 310 grammes of the 50 per cent. sugar solution, which was then concentrated. 104·8 grammes of water were evaporated, and the contents of the flask emptied into a glass. The *masse cuite* contained :—

	Grammes.
Sugar	155
Saltpetre	10
Water	50·2

Crystals of sugar appeared when the temperature had fallen to 120° Faht., and their quantity increased gradually. If saltpetre retains five times its weight of sugar in the molasses, then only about 5 grammes of sugar altogether ought to have crystallized, and at 120° Faht. no crystals ought to have appeared.

This experiment was repeated with 20 grammes of saltpetre. The *masse cuite* contained :—

	Grammes.
Sugar	154·5
Saltpetre	20
Water	50·4

At 120° Faht. crystals of sugar appeared, the saltpetre crystallized with the sugar when the temperature fell to 60° Faht.; but at 120°, when all the saltpetre was still in solution, the crystallization of the sugar was not prevented, which ought to have been the case if this salt could be credited with a saline coefficient of only 2·5.

3rd Experiment.—Made with a mixture of salt and saltpetre.

Into the flask containing 246·5 of syrup of 50 per cent. of sugar

were thrown 10 grammes of chloride of sodium and 10 grammes of saltpetre; 90 per cent. of water was evaporated, and the *masse cuite* then contained:—

	Grammes.
Sugar	123·25
Salt	10
Saltpetre	10
Water	33·15

No crystals of salt were produced at either a hot or cold temperature. In cooling, a considerable quantity of crystals of sugar was produced, which was greatly increased by stoving. Thus the mixture of the two salts does not prevent crystallization in the proportion demanded by the coefficient 5, nor even by the coefficient 2·5.

Some analagous experiments made with chloride of calcium and oxylate of ammonia led to the same results.

4th Experiment.—Sugar, chloride of sodium, saltpetre, and uncrystallizable sugar.

With the same proportions of the two salts there was also thrown into the flask 24 grammes of inverted sugar, in the form of a syrup containing 31·85 to 100 of water. 90 grammes of water were evaporated, beside 11·1 grammes for the inverted sugar, *i.e.*, 101 grammes; the *masse cuite* contained:—

	Grammes.
Crystallizable sugar	123·25
Uncrystallizable ditto	24
Salt	10
Saltpetre	10
Water	33

This water being able to dissolve 66 grammes of sugar, the supersaturation is 57 grammes. According to generally received ideas, the salts are able to retain 100 grammes, and the uncrystallizable 24 grammes; all crystallization then would appear impossible. Nevertheless, numbers of crystals were found in the stove, and the entire mass of sugar was recovered at the end of some days.

In the fifth experiment gum and caramel were introduced into the mixture, and the concentrated syrup was composed as under:—

Crystallizable Sugar	123·5
Uncrystallizable Sugar	32·4
Gum	10·0
Caramel	20·0
Salt	10·0
Saltpetre	10·0
Water	48·1

These 48 grammes of water are able to dissolve 96 of sugar, therefore, the super-saturation is only 27·6 grammes of sugar. As small quantities of crystals of sugar were formed in the stove at 150° Faht., thus the 20 grammes of salt, notwithstanding the presence of considerable quantity of organic matter, were not able to retain in solution a single gramme of sugar, for at this temperature the water can dissolve a larger quantity of sugar.

If then, the preceding experiments confirm the opinion of M. Scheibler regarding mineral salts, they also show that when his experiments are extended to uncrystallizable sugar, gum, caramel, &c., we must refuse to these substances, also, any special power of holding sugar in solution.

In fact, these experiments simply prove that the sugar retained in molasses, is not in chemical combination with a chloride or dissolved by uncrystallizable sugar. It is needful then to seek in the physical character of the molasses for the theory of their formation.

In comparing together the various concentrated syrups of the previous experiments, we see that the addition of uncrystallizable sugar gave to that of No. 4 a strikingly viscid character. Instead of crystallization being produced on cooling or at a temperature of 68 to 78° Faht., it was needful to keep the syrup at nearly 90°. The syrup of No. 5 was still more viscid and required a stove heat of nearly 150° Faht. to produce crystals. Whilst the viscidity impeded crystallization it also hindered concentration; thus, in experiment No. 5 it was impossible to carry concentration any further, and on this account the 77 grammes of foreign matters which could not retain in solution the 27 grammes of sugar of

super-saturation, prevented the evaporation of the water which held the 96 grammes of sugar in solution. In actual manufacture such a syrup would not crystallize at all, or so slightly as not to be worth reboiling.

As the introduction of uncrystallizable sugar into the mixture gave to the syrup of No. 4 experiment its viscid character, let us examine the influence of this substance on the crystallization of pure sugar. In the sixth experiment a concentrated syrup was obtained composed as under:

Crystallized Sugar	122·0
Uncrystallized Sugar	25·0
Water	42·8

when hot it was very fluid and not evaporated to proof. In cooling some crystals of sugar appeared sprinkled through the syrup, when cold it became thick, but the crystals did not increase in number or size. Placed in a stove at 95° Faht. a mass of crystals was produced in a very short time. This experiment being repeated and the syrup evaporated to a higher density, crystals were clearly formed in cooling, and they increased in quantity in the stove.

The seventh and eighth experiments were made on mixtures containing a still larger proportion of uncrystallizable sugar, in the latter nearly half, in which instance a sticky mass was produced, which could not be evaporated sufficiently to produce crystallization. The ninth experiment was made with an excess of uncrystallizable sugar, when the effect was very clear, as it prevented the evaporation of the syrup to a point at which crystallization is possible under ordinary circumstances. When in small proportion it simply renders crystallization more difficult, but when concentrated in low syrups the effect of uncrystallizable sugar, either alone or in combination with other uncrystallizable substances, is invariably to prevent sufficient evaporation.

* * * * *

The preceding experiments prove sufficiently that the saline method does not establish on a scientific basis, the theory that one part of salts renders uncrystallizable five parts of sugar; it is certain that the organic matters and uncrystallizable salts exercise

a direct influence on the formation of molasses, but if the determination of the ash of a raw sugar can serve as a basis for a satisfactory valuation of the yield (of pure sugar), it is because the proportion of the ash to the total impurities is nearly constant, as in a great number of analyses this proportion has only varied between 45 and 65 per cent. The variations of the saline coefficient are about the same. As we have said before "without being the exclusive cause of molasses the salts are the best indicators of the quantity of molasses which will be produced, because except the small quantity absorbed by the charcoal the salts are all concentred in the molasses. But when from any cause the proportion of the ash to the total impurities varies much from the average of 53 per cent., then the indications furnished by the saline method are incorrect or of no value. Thus, for example, the raw sugar mentioned by M. Anthon as containing 22 per cent. of saltpetre could not have been fairly valued by the saline method alone. For beet sugar these exceptions are rare, but for colonial sugars the saline method is altogether unsuitable, as in these sugars the whole of the impurities should be ascertained."

If then we admit the determination of the ash as a base for the valuation of the yield of raw sugars we must not endow every other impurity with a special coefficient. To assert for the establishment of the coefficient 5, that the salts only intervene in the formation of molasses, and then to give the buyer a special coefficient for uncrystallizable sugar cannot be allowed.—*Journal des Fabricants.*

THE USE OF LIME IN THE EXTRACTION OF SUGAR FROM MOLASSES.

THE *Journal des Fabricants* draws attention to the fact that the extraction of sugar from molasses by the use of lime, long one of the favourite problems of chemistry, and for which several new processes have lately been patented, was the subject of some exhaustive experiments about ten years ago by M. Stammer, the results of which appeared in the *Polytechnisches Centralblatt* of 1859 and in the *Jahresbericht de Scheibler and Stammer* of 1861-62,

As these experiments are of considerable interest we translate the account of them from the French version given by our contemporary:—

"When quick lime is added in a dry powder to molasses diluted with a definite proportion of water, a granular precipitate is obtained which it is easy to separate from the molasses and which after being washed with water is of a bright yellow colour. But if the lime added is more hydrated or if the molasses is more diluted, scarcely any precipitate is formed; if the molasses is *too* concentrated it forms with lime a sort of jelly which is unfavourable to subsequent processes.

It is very likely that the requisite proportions have hitherto escaped observation, and doubtless this is the reason why it has been considered impossible to precipitate sugar from molasses by lime.

The following experiments which can easily be repeated by any one will establish the true proportions:—

Mix 200 grammes of dry hydrated lime (slaked lime) with 1,000 grammes of molasses of normal density, add immediately 570 grammes of water, stir thoroughly, allow to settle and then decant. The precipitate obtained pressed by hand weighs about 600 grammes. This mode of procedure is subject to too many variable circumstances to be always successful.

If on the contrary the molasses is diluted so that it registers exactly 28¾° Baumè and if to this is added dry slaked lime we invariably obtain the satisfactory granular precipitate given above. So long as the proportions of water and molasses are preserved, the quantity of the lime does not much influence the result, as successive precipitates may be produced by adding more lime to the decanted liquor; neither does temperature appear to exercise much influence. The precipitate thus obtained is so difficult of solution in water that it may be washed several times, and a bright colour produced without much loss.

In one experiment in which 500 grammes of molasses at 28¾° Baumé were used, 100 grammes of lime produced 233 grammes of yellow sucrate.

In an experiment made on a larger scale 90 kilos of molasses produced by successive additions of lime 62 kilos of sucrate.

The precipitate contained 27 per cent. of water and 30 per cent. of calcareous ash.

This sucrate appears to be as pure as could be wished, and we may conclude that it does not contain more than lime, water, and pure sugar.

We might then hope that by the elimination of the lime a very rich syrup would be left having a high co-efficient of purity. We know that the co-efficient of purity, or the proportion between the sugar and the whole of the substances dissolved, is fixed by a saccharimetrical observation and a determination of the density by Balling's areometer. The salts exercise a decided influence on the determination of the density so great that the action of other impurities may be neglected. As it is difficult to admit that the lime will precipitate any notable quantity of the salts contained in the molasses, the co-efficient of the purity of the syrup produced from the sucrate formed ought to be very high and give promise of a rich crystallization.

Analagous phenomena observed with baryta render these conclusions still more probable.

Notwithstanding all these reasons, many saccharimetrical determinations of syrups obtained by the elimination of the lime from the sucrate, have invariably led to the same figures as determinations of the primitive molasses. There may have been some variations, but so slight as not to be worth notice. Thus the co-efficient of purity of the normal molasses varied between 59 and 61, and the syrup obtained from the sucrate gave 59, 60, 61, and up to 63. Various agents were employed to eliminate the lime without any better result being obtained.

Thus as we said above the low saccharimetrical valuations not being attributable to the precipitation of salts by the lime we were obliged to conclude that there were errors in the indications caused by the presence of some active substance. If this supposition were correct an experiment on a large scale would lead to a considerable crystallization in consequence of the absence of salts which retain the sugar in molasses.

We therefore made a trial on a large scale to decide this important question.

A considerable quantity of molasses was treated in the manner indicated. The granular precipitate thus obtained was washed in water and placed in an ordinary carbonatation copper with some hot water. After carbonatation it was heated to the boiling point and the syrup then passed through bag filters to separate the carbonate of lime. Then placed in a double-bottomed copper the syrup was mixed with a considerable quantity of animal charcoal and boiled for a sufficient length of time. After another filtration through bags containing fine charcoal, the syrup was boiled to proof in a double-bottomed pan and cooled in sugar moulds. To prevent too rapid cooling these moulds were placed in cisterns of hot syrup.

Though we do not pretend to have thus realised all the conditions necessary for producing a good crystallization, yet if the improvement in the syrup by sucratation was as complete as it was hoped some crystals at least ought to have appeared at the end of several weeks, but there was no trace of crystallization and the indications of the saccharometer were thus fully confirmed by the experiment in actual manufacture.

The result certainly appears abnormal, and the facts are difficult to account for. But it is easy to prove that there has been no sort of illusion, by operating on still richer syrups, with which there is little or no difficulty. If the addition of lime produces an elimination of a greater proportion of sugar than of foreign matters, the impurities will accumulate in the liquid residue and should show their presence there by a notable diminution of the co-efficient of purity.

Numerous experiments made with the aim of testing this have invariably given opposite results. Thus for example a syrup polarising 83·5 per cent. (or having a co-efficient of purity of 83·5) was treated by lime, and after as complete sucratation as possible the liquid remaining treated by carbonic acid gave the nearly identical co-efficient of 83·2.

There is then but little hope that the phenomena of the precipitation of sugar by lime which appeared to promise such rich results will be of any importance in the practical sugar manufacture.

THE DIFFUSION PROCESS.

A correspondent in St. Croix enquires respecting an establishment in the East Indies where the cane is "split, steamed, and pressed" by which means he has heard it said "a much better return of sugar is secured than by the rollers."

We suppose our correspondent refers to the Aska Sugar Company's establishment in the Madras Presidency where the diffusion process which is employed in many parts of Germany for the extraction of beet juice has been successfully adopted in the manufacture of sugar from the cane.

The process which was invented by M. Julius Roberts of Seelowitz in Austria is based on the same principle as the Osmogene. The words diffusion, osmose, dialysis, express the same force in virtue of which liquids penetrate into the extremely fine pores of bodies.

It occurred to M. Roberts that if the beets were cut into fine slices, a comparatively small quantity of water would absorb from them their saccharine richness without greatly lowering the density of the juice, and that the juice thus obtained whilst not much poorer in sugar would contain much less of foreign noxious substances than juice obtained by the heavy pressure of rollers, and that the residue not having been deprived of its gummy matters would be of greater value for cattle feeding than the ordinary pulp.

The process invented by M. Roberts, and which has been adopted by above fifty beet sugar manufacturers in Europe, may without going into minute particulars be thus briefly described. The beets are cut by machinery into slices 3 or 4 inches long, 1 inch broad, and $\frac{1}{24}$ of an inch in thickness.

Five cylinders are placed side by side, and in communication with each other, each capable of holding 30 cwt. of sliced beet root and the same weight of water. These cylinders are systematically charged thus: five cwt. of beet slices, then the same weight of water at a temperature of 190° Faht., and so on alternately till the cylinder is full. The second cylinder is charged in the same way, except that instead of water the juice from the first cylinder is used

with fresh slices of beet root, the third cylinder receives the juice from the second, the fourth from the third, and the fifth from the fourth, fresh beets being used in each cylinder with the same juice throughout. The juice remains in each cylinder about half an hour; changing and emptying occupy another half hour, so that the whole operation lasts about four or five hours from the commencement of charging, and when the liquid has passed through the five cylinders it has acquired such a density that when the first cylinder receives the water for the sixth time the juice of the fifth may be sent to the defecation coppers. The water which it contains causes it to be a degree less dense than the undiluted juice of the beet root.

One battery is capable of operating on about 8 tons in 24 hours, so that two or more batteries are necessary in most beet sugar factories.

Some few years ago the process was applied to the extraction of the juice from the cane at the works of the Aska Sugar Company, Madras, and a report on the subject by Mr. Ferdinand Kohn, the Company's engineer, was issued last year. From this report we learn that the results of three years experimental working, and particularly those of the last season which were conducted on a commercial working scale have proved the great advantages of the new invention in the extraction of sugar from the cane.

The company have found a steam engine of 12 horse-power, to be sufficient to work the entire diffusion plant. Four cutting machines have cut on an average throughout the season 70 tons per day. The total quantity of cane cut has been 3,300 tons. Two batteries of 10 diffusion vessels each have been used, but these we understand have lately been superseded by a single diffusion vessel greatly simplified in its working. If this proves as efficacious in extracting the juice as the battery, one great objection to the process will be removed by saving the time spent in passing the juice from one vessel to another.

The actual quantity of water with which the diffusion juice is diluted is about 20 per cent. of the whole, *i. e.*, in the diffusion juice there is 20 per cent. more liquid requiring evaporation than

in juice from the ordinary cane mills; on the other hand it is stated that the diffusion juice is much purer than mill juice and that much less saccharine remains in the sliced cane than in the megass, thus that a larger per centage of sugar is extracted from the cane than by the ordinary method. Two analyses which we extract from the report will show the comparative purity of 100 parts of mill and diffusion juice.

	Mill Juice.		Diffusion Juice.
Water	81·842	....	85·192
Sugar	16·758	....	13·625
Glucose	0·761	....	0·723
Organic substances .	0·27	....	0·19
Salts	0·369	....	0·270
	100·		100·

As regards the yield from the cane we cannot do better than quote the following:—

"The quantities of cane charged into the battery were carefully registered throughout the whole season, the quality of the cane was tested from time to time by extracting a small quantity from the cane in a small roller mill and testing the quality of the juice; the density of the diffusion juice and its chemical composition were carefully noted and registered, and the quantity of juice delivered to the clarifier regularly measured.

The following table shows the quantity of juice produced during one week:—

Cane worked.		Diffusion juice produced.		Density of juice.	Quantity of green sugar in the juice.	Per centage of green sugar in the juice upon the cane worked up.
Tons.	Cwts.	Tons.	Cwts.	Degrees Ball.	Cwts.	
578	8	628	6	13·500	1696	14·6 per cent.

The yield of green sugar, *i.e.*, of saccharine matter, salts and organic substances in the diffusion juice produced was 14·6 per cent. upon the weight of cane worked up.

Comparing this yield with the actual composition of the cane, the analysis shows in the cane the following per centage;—

90 per cent. juice of 17 degrees Balling.

10 per cent. wood fibre and solid matter.

The per centage of green sugar dissolved in the cane juice is therefore $= \frac{90 \times 17}{100} = 15{\cdot}3$ per cent.

From this absolute or theoretical per centage existing in the cane, the quantity of 14·6 per cent. has been extracted by diffusion. This represents a yield of 95·4 per cent. of all the sugar actually existing in the cane.

The remainder, amounting to 4·6 per cent., is to be accounted for as follows:—

Sugar left in Trash . . .	1·6 per cent.
,, ,, in Waste Water .	3·0 ,,
	4·6 per cent.

In order to compare the yield of green sugar in the diffusion juice with the per centage or yield obtained from the ordinary sugar mills, it will be found that the total quantity of juice in the cane, which is 90 per cent., represents a yield of 15·3 per cent. of dissolved green sugar. The yield of the diffusion juice being 14·6 per cent. of dissolved green sugar, represents, therefore, an equivalent of $\frac{14{\cdot}6 \times 90}{15{\cdot}3} = 84{\cdot}5$ per cent. of mill juice.

The yield of mill-juice, from the best mills in existence, is only from 70 to 75 per cent., while the average of sugar mills does not extract more than 60 per cent. of juice from the cane. The diffusion process is therefore capable of increasing the yield of the cane by 13 per cent., when compared with the very best practice of modern roller mills, and it increases the yield by 42 per cent. when compared with the average working of sugar mills in the greater number of sugar growing countries and colonies."

It appears that the cane slices are easily dried in the sun so as to be available for fuel like ordinary megass, and that the labour required in the whole process is not more than in roller mills crushing a similar amount of cane. It cannot, we think, be denied that the diffusion method is less expeditious than the ordinary mode of manufacture, though probably the substitution of one diffusion vessel for the battery will obviate this objection to some extent.

The quantity of *pure* water requisite is considerable, and this alone would prevent the adoption of the process in some colonies. The 20 per cent. extra evaporation required is also a drawback, and points to the desirability of more expeditious methods of concentration than the ordinary ones being adopted in connection with the diffusion process.

FRENCH VIEWS OF THE REDUCTION OF THE BRITISH SUGAR DUTIES.

From La Sucrerie Indigene.

What has with us given rise to endless discussions, delays, and difficulties, and with our ministers to many ifs and buts, the English Government has accomplished in a single sitting of Parliament. With the prospect of a surplus of over four million pounds sterling the minister has proposed a reduction of 50 per cent. of the duties on sugar. This resolution was passed at the sitting of the 11th of April and with a delay of only three weeks the new duties will be in full and entire operation.

Happy country which counts among its ministers a Robert Peel, a Gladstone, and a Bright, and where the budget is not a house of cards which the least shuffle of reform can overturn! Happy country where the love of business takes the place of the political excitement which we dissipate in sterile struggles, which sow among our citizens those germs of disorder and dissolution so fatal to the interests of agriculture and industry.

For us the mere mouthpieces of public opinion, it is our duty to say it, we must not deceive our readers; that it is probable we shall yet have much paper to cover before we reach the same result as our neighbours. So be it!

From the Journal des Fabricants.

The duty on sugar in England is reduced fifty per cent., and this measure so anxiously awaited by English and European commerce, so far as regards raw sugars came into full operation on the 12th April, the day after the proposition was submitted to

Parliament, and for refined goods the new tariff will come into force on the 1st of May.

It was on Monday the 11th at five in the evening that the budget speech was commenced and the propositions of Mr. Lowe laid before Parliament, and a dispatch which we received a few hours later informed us of the happy result. During this time our country passing through one of those political crises only too frequent, allows to pass unperceived one of those reforms which form an epoch in the life of a people, and which our internal preoccupations still more than our financial embarrassments unfortunately prevent us from rivalling. It is not, however, indifferent to the fact that the English people will only pay 12 centimes duty on sugar, whilst in France we shall continue to pay 44 and consequently to furnish a contribution from this source to the revenue of 120 millions of francs instead of 30 millions if we were equally placed. This will interest our readers as much at least as to know who will succeed M. Buffet or M. Daru, and in what terms the senatus-consultum which is to be presented to the people will be drawn up.

It is six years since at this period that Mr. Gladstone, inspired by a policy which may be traced to Sir Robert Peel, effected a considerable modification of the duties on sugar amounting to a reduction of thirty per cent. Some changes were made (necessitated by the convention) on the 1st of May, 1867, and the average then was about ten shillings per cwt. A reduction of fifty per cent. on this is an event as fortunate for the English people as it is important to the sugar trade in general.

The consumption of sugar in the United Kingdom is in round numbers 600,000 tons per annum, and under the old duty would have assured to the Chancellor of the Exchequer six millions sterling. With the new duty the revenue from sugar will not reach three millions, but what a great compensation the English Government will find in a measure so productive of good to the population and to commerce in general, which will return this sum through a thousand forms of industry from the increase of wealth and public prosperity of which the surest basis is moderation and justice in taxation. It is necessary that statesmen in possession of

such a large source of revenue as this of which we have spoken should be moved by powerful considerations of a very high character to induce them to abandon half of it; and we ask ourselves whether our metaphysician ministers will find in Aristotle, Plato, Montesquieu, or Bacon, inspiration of which they will not be long in seeing the effects, and of which the results will assuredly be to assure to England the monopoly of the commerce in sugar. . . .

It is very probable that the reduction of fifty per cent. in the duties will in the course of a few years lead to the consumption in England reaching 700,000 or 800,000 tons, at the same time the lightness of the new duty averaging 5/0 per cwt. will greatly lessen the effect of the differential scale and cause the disappearance of certain inconveniences of the Convention of 1864. There would be no difficulty about sugars if there were no duties, from whence this logical conclusion may be deduced that the difficulties of the problem are now lessened one half. As regards France our producers will be less limited than formerly in their choice of sugars suitable for export to England, and they cannot but find their way the more easy inasmuch as they have to deal with a tariff which has taken so great a step towards simplification and universality. But it is impossible for an industry like that of beet sugar to depend for its future progress exclusively on export; the price of any product exported is not that of the same product consumed at home, and all the laws of political economy and national prosperity will be overturned and falsified if the home consumption do not increase in proportion to the increase of production. That "devouring activity" which our ministers recommend to the prefects, they would do wisely also to recommend to the consumers of sugar, reserving to themselves the means of satisfying it.

The question of the reduction of sugar duties in France is thus placed more prominently than ever before the Chamber and the Government which have only to consult the numerous volumes of agricultural research, and advise with the Councils of Arondissements and the Chambers of Commerce in order to learn that this question is warmly advocated by our agriculturists, our manufac-

turers, and our tradesmen, who are astonished that Government is so tardy in taking up the question. * * * * *

Let us hope that the glory of Robert Peel, of Gladstone, of Bright, of Lowe, of all those English statesmen whose ambition has been to secure to their country greater benefits than political liberty can always ensure—let us hope that this glory will touch the minds or the hearts of our ministers, and that parliamentary storms being lulled we shall see them at work securing to us the enjoyment of the benefits of reduction, but since it is well not to expect favours, and since reforms which come from beneath are as good as those which come from above, let our producers take the lead and rely in the first place upon themselves to effect a triumphant economical reform to which they have a right, and which has been promised them for ten years.

SUGAR PLANTING IN QUEENSLAND AND NATAL.

From the "Natal Mercury."

THAT Natal possesses the attributes of a successful sugar growing country is a proposition which, we imagine, only a few gloomy-minded individuals will be inclined now to dispute. In the face of every conceivable difficulty sugar planting was first established as a local industry. In the face of vicissitudes adverse enough to crush many another industry, sugar planting has held its own, has pushed its way, has asserted its position, and is now generally admitted to be an enterprise which under certain conditions can be advantageously followed out.

Of late years the tendency of local enterprise in this respect has been rather in favour of the working of estates conducted on a large scale by means of adequate capital, and to this end companies of home capitalists have in several instances been formed. That this line of action is a sound one we have no reason to doubt, but we think that the principle of co-operation might be applied to industry as well as to capital. The establishment of central factories has been found to succeed in the French colonies of the West Indies. Instead of a planter being his own manufacturer, he gets his cane

crushed and his sugar made at a central mill. Instead of a man having to spend capital in the purchase of machinery as well as in the cultivation of the soil, he is enabled by this system to concentrate all his energies upon the growth of the cane. We have often suggested that this plan would suit Natal where the climate is suited to European settlers, and where we hope to see a large European community located in a flourishing condition. The two operations of tillage and manufacture form together an undertaking which exceeds the capabilities of ordinary individual settlers. Were they separated we might see sugar planting extend itself to unforeseen limits, and we might bring this industry within the reach of a class which is now debarred from pursuing it.

It has been often said in Natal that sugar planting was not a pursuit for men of small means, or for countries devoid of coloured labour. In Queensland the converse of both these propositions is being proved. There men of every grade of means are engaged in the cultivation of cane and the manufacture of sugar.

There is no reason that we know of why Natal with her cheap land and cheap labour, should not be studded with plantations as small as those in vogue in Queensland. There a plantation of twenty acres seems to be regarded as a considerable undertaking, and we are moved by this fact to suppose that the amount of labour employed on such miniature estates is confined to that of the proprietor and one or two white hands. One mill which is highly lauded as a truly Queensland institution, such "as we hope to see upon every plantation of *over twenty acres*," was made at a colonial foundry, and cost complete, with battery of four pans, tache, cooler, drainers, shed, curing-house, horse-walks, &c., about £420. This little mill is driven by horse power, and at full work turns out an excellent brown sugar at the rate of four tons per week. There are twenty acres of cane to crush on this estate, and the proprietor is entirely self-taught. The yield from the cane, which is all Bourbon, is about two and a half tons per acre, and the density 10½. None of the plantations mentioned in a long list exceed twenty acres. This is a matter worth enquiring into. We suspect that in Queensland there are large alluvial bottoms, where

the richness of the soil compensates for scantiness of area. Frost, however, is felt there badly—ribbon cane and also Bourbon suffering most. Otaheite cane is said not to be affected. Can this variety be identical with our China cane? Probably it is. Sugar planting has evidently taken root in Queensland, despite its want of coloured labour, and its lack of experience. A writer speaks in glowing terms of the bustle and life that is apparent everywhere—the miles of luxuriant sugar cane, the magnificent appliances for sugar-making and for distilling, and the active industry, everywhere visible, of men cutting and planting cane, teams ploughing and drawing loads of cane to the mill, "in a manner quite refreshing to those so long used to the hum-drum existence of Bowen."

This question of central factories and small plantations is exactly one which such a body as the Chamber of Agriculture might advantageously consider. In connection with German or Chinese immigrants it would be very applicable. But why these principles of action should succeed among English settlers in Queensland and not here, we have yet to learn.

We have at times suggested that the Wire Rope Tramway system seemed well adapted to the circumstances of our sugar estates. In this opinion we are now corroborated by a practical planter—Mr. Bazley, of the Ifafa—who writes to us that he is so convinced of the applicability of this system to sugar estates in Natal and of the economy in working it will effect, that he intends to order a mile or two of it. We should be glad to see the plan tried in a practical manner.

NOTES FROM THE LABORATORY OF A SUGAR REFINER.

BY WILLIAM ARNOT, F.C.S.

(*From the Chemical News.*)

IV. THE CHEMICAL IMPURITIES OF "LOW" BEET SUGARS.

As a rule, the finest products of the beet are manufactured directly into loaves in the various beet growing countries; the second,

or perhaps more frequently the third crop of crystals being exported.

British refiners are thus called upon to deal with sugars containing large proportions of chemical impurities, some of them very injurious to the sugar itself, while others act most prejudicially on the charcoal used in the refining process. Amongst these agents, sulphates usually hold a prominent place; it is needless to say that their action is just as injurious in the product of the beet as in that of the cane. Alkaline chlorides also abound, and their action is at least as injurious as that of the sulphates. Any one who has had the opportunity of observing beet sugar liquor, and cane sugar liquor, of the same original colour, passed through separate cisterns of the same charcoal, must have been struck with the very great difference in the effect produced: the cane liquor bright and colourless; the beet *possibly* bright, but decidedly yellow; and this difference is rather increased than lessened by the after process of boiling. The share which the alkaline salts have in reducing the colour value of the refined product is unquestionable, and their injurious action does not end there; they tend throughout the whole refining process to destroy crystallisable sugar, while their action on the charcoal, unless when very copious washing is practised, is very objectionable. The salts referred to, being fusible, the risk of coating the char in the re-burning process is considerable. Several otherwise good chars, which have been sadly injured in this way, have come under the author's observation. The practical point to be observed is this, that whereas even the very lowest "beets" commend themselves to the eye, in virtue of the size, strength, and abundance of the grains, or crystals, they are often so charged with potent impurities, as to be entirely inadmissible as subjects for the British refiner to operate upon. The evil effects of the repeated use of such low class beets, soon manifest themselves over the whole refining establishment—not least on the sale-room counter.

The foregoing has, of course, little or no reference to the beautiful first products of the beet, occasionally imported, though even these are tainted, to a greater or less extent, with some of the characteristics of the low beets.

In the circumstances here noted, it must be manifest to every refiner, that to purchase beet sugars, or indeed any sugar, as will be evident from a perusal of the preceding (III.) note, by the rule-of-thumb system, so generally prevalent, is, to say the least of it, very risky.

Nothing but rigorous chemical examination can point out the true commercial value of unrefined sugars. The eye can detect many useful indications of quality, but these ought always to be supplemented by an investigation of the qualities which do not appear on the surface, and which chemical analysis alone can reveal.

Dubrunfaut, who, along with other continental chemists, has made the action of the impurities of beet upon the crystallisable sugar a special study, has fixed upon a co-efficient by which to arrive at the quantity of *extractable* sugar contained in any sample submitted to analysis. The removal of these objectionable salts has also engaged the attention of several eminent continental chemists, and from the results obtained, it is manifest that other methods of dealing with beet sugars must be adopted from that followed in the refining of the produce of the cane. We, in Britain, seem to have fallen asleep upon this subject. The process of sugar refining is eminently a chemical one, and at every stage there is room for investigation and improvement.

VIII.—Char "Diseases."

The "diseases" to which animal charcoal is subject are very varied in their nature, and proceed from widely different causes. Upon this subject some very erroneous ideas are entertained by many of our refiners, as well as by scientific men. The manner in which certain specifics have been recommended and employed, with a view to cure almost every variety of "disease," testifies to the truth of the assertion. It is the writer's intention in this note briefly to notice the several diseases which have come under his own observation, and with the cause and cure of which he has more or less to do.

1. *Deficiency of Carbon.*—This is a very serious defect, and one

much more prevalent than might be supposed, considering that, in certain classes of refineries, the carbon increases, rather than diminishes, by continued use. A good working char should contain from 9 to 11 per cent of carbon; when it falls below 9, some agency is at work which ought at once to be inquired into. Faulty slides or joints will be admitting air to the ignited char in the kilns or coolers: or the system may be such that the char has to pass through the air on its way from the kilns to the coolers: in either case, a portion of the carbon is oxidised, and the proportion consequently reduced. Or the re-burning may be conducted at too high a temperature, a reaction taking place, in consequence, between the carbon and water—the latter being decomposed, and compounds of the former formed; or, further, deficiency of carbon may arise from the use of sugars containing large proportions of sulphates and sulphites, as indicated in Note III. The cause discovered, the cure is simple—have the kilns prepared, or renewed; re-burn at a more moderate temperature; avoid the use of sugars impregnated with sulphates and sulphites. Of course, attention to these points cannot restore the carbon already gone, but will prevent a further reduction of this valuable agent; the carbon may, indeed, increase, but it is questionable whether the increase will improve the quality of the char. The want of carbon is one of the worst diseases incident to animal charcoal—the reduction of that agent from 9 or 10 per cent to 6 or 7 means a reduction in decolourative power very much greater than these figures indicate; the preservation of the carbon ought, therefore, to be a special study of the refiner. The writer has before him at the present moment a sample of char from a working stock of several hundred tons, containing under 5 per cent of carbon; how a refinery with such a char stock can yield a profit to the refiner is more than he can guess.

2. *Excess of Carbon.*—As already indicated, the carbon usually increases by continued use; in some refineries this increase is rapid and great, so great, indeed, as to amount to a "disease." This disease may arise from defective washing, or from the use of water containing considerable quantities of vegetable matter. The

deposit of carbon, by the decomposition of organic matter in the process of re-burning, clogs up the pores of the char, just as any other impurity does; its injurious action ends there, however, having no active deleterious action in itself, as some other impurities have.

3. *Oxide of Iron.*—The presence of this agent in any considerable quantity may well be considered a "disease:" it is most injurious and potent in its action. The faintest trace of iron in the refined product at once manifests itself on the addition of tannic acid or tea; and so injurious to the commercial value of the sugar is the presence of even the minutest quantity of that agent, that its avoidance is worth any expenditure of care and cash on the part of the refiner. Iron may accumulate in char from various causes—in the process of re-burning there is, no doubt, a slight and unavoidable increase, but with care, this need not be serious; if, however, defective kilns and careless manipulators are employed, this may prove a very fruitful source of iron. Here, therefore, is another inducement to the refiner to attend to the careful maintenance of his re-burning apparatus. But a more general source of iron is to be found in the action of sour or acid "washings," "scum-waters," &c., upon unpainted or defectively painted cisterns, moulds, &c. These "washings" impregnated with iron are used in dissolving raw sugars, or are concentrated and run through fresh char; a portion of the iron is extracted by the char and is ready to be given up to the first acid liquor that follows. There is thus a constant addition and abstraction of iron, which become about equal when about 0·7 per cent of oxide has been incorporated with the char. A thorough system of painting, with the avoidance of acid liquors, waters, &c., as far as practicable, is recommended. A portion of the iron may be removed from char suffering from this disease by the use of dilute hydric chloride and some other agents; but, as this subject will be treated of in a separate note, it need not be the subject of further remark here.

4. *Lime*—Accumulations of this agent in the pores of the char reduce the potency of the char as a decolouriser, and may otherwise injuriously affect the sugar liquors passing through it. This

is not a disease very common in this country—at least, not to any serious extent. Several refiners, fancying their char was loaded with this agent, have expended large sums upon curative processes, but generally to no purpose, as the lime was more usually found to be deficient that excessive. Beanes's most admirable process for the removal of lime from char has, to a certain extent, failed in this country—not from any defect in the process, but from a want of the material to operate upon. A more ingenious and trustworthy process *for the removal of excess of lime* could not well be devised; and, on the Continent, where lime rapidly accumulates in the char in the process of refining "beet," the patent process would yield most excellent results. The writer has, on more than one occasion, had cause to feel surprise at statements made about Mr. Beanes's system, especially by chemists. It was defective because you could not wash the char free from acid; could not regulate the supply of gas to the requirements of the char; and other statements have been made, which simply show that the process was never understood by the parties making them. The process is free from all such objections, and, where lime exists in such excessive proportion as to render its removal desirable, no fear need be entertained with regard to the application.

5. *Overburned Char.*—Char that has been repeatedly overburned contracts—shrivels up, so to speak; the pores become smaller, or cease to exist. This is a serious defect, and one which cannot be remedied.

6. *Glazed Char.*—The glazing of the char has been attributed to several causes by different writers; but the author, though he has given some attention to the subject, is by no means satisfied as to the real cause or causes. Friction may have something to do with it; but this is not the initial cause: defective washing will be more likely to account for it. That glazing is injurious to char is beyond question: when chars become very highly glazed, their decolourative power is more or less reduced.

7. It is only necessary to indicate that two or more of the above diseases may obtain at the same time, and that complication of diseases renders successful treatment very difficult of attainment.

IX. Char Treatment.

When a refiner discovers his char stock to be in a "diseased" condition, he naturally begins to look about for some method of treatment, by the adoption of which the quality of his char may be improved. The search is usually made in a hap-hazard way; no very definite notion of what the disease really is which effects his char having been obtained, a process for the removal of iron or lime may be adopted when the real source of the inefficiency of the char may be excess or deficiency of carbon, or such like. The first step which ought to be taken when a char ceases to give satisfactory results is to have it carefully analysed; but this will be of comparatively little use if analyses have not been formerly made. A regular monthly or bi-monthly analysis of every refining stock should be made, and the results of each compared with those preceding; the refiner will thus be able to trace the nature and progress of disease in his char, if any exists. If suspicion is thus aroused that all is not right, more frequent analyses should be made, and, at the same time, some well-considered system of treatment adopted. It may be well to draw attention here to the obvious necessity for such analyses being made with rigorous care. An increase or decrease of carbon from week to week or from month to month of 0·5 per cent., increase or reduction of calcic carbonate to the same extent, or an increase of iron to the extent of 0·1 per cent. of oxide, are most important indications, and ought to receive the special attention of both analyst and refiner.

A fair idea of the nature of the defect having been obtained, the mode of treatment most likely to improve the char must be carefully considered. It will very frequently be found that the safest, most efficient, and, in the end, least expensive course to follow will be to increase the washing; to use the washing water boiling, instead of simply "warm"; to see to the kilns and coolers being tight, and the working of them specially attended to; to reject suspicious sugars; and generally to give greater attention to the employment of careful and efficient workmen. The writer has more faith

in measures such as these, than in the hasty adoption of special systems of treatment, which often lead to mischievous results. But, in the face of every precaution, "diseases" do creep in sometimes, and the adoption of some special measures may be imperative; but, whatever the system to be adopted, numerous and frequent, carefully conducted, small-scale experiments should first be made. The diseases open to special treatment are, as indicated in the preceding note, principally excess of lime and iron. For the removal of these, the following processes have been adopted with more or less success.

1.—*Fermentation* of various kinds and degrees. The char may be left in the cisterns with a little "sweet" remaining in it (*i. e.*, without being thoroughly washed) for some days, during which time a brisk action will take place: the traces of sugar, as well as the several organic impurities left in the char, are decomposed, with formations of various weak acids, which combine with the lime, forming salts easily removable by washing. Or a quantity of "sour water" may be run upon the char, and allowed to stand as before; the action will be the same, slightly intensified. Many modifications of this system are in use, the action in all cases being the same in kind, differing only in degree. Crude acetic acid and churned milk have also been used to promote and intensify acetic and lactic fermentations.

Fermentation is a simple and cheap mode of treatment, but the results, although generally in the right direction, are not usually very great. The amount of acid produced is comparatively trifling, and has seldom any action upon the iron, enough lime being generally present to saturate the acid as produced. It has its harmlessness to recommend it; but it keeps the char an objectionably long time out of use, and, moreover, monopolises the char cisterns to a serious extent. This latter objection may be got over by adopting a system of "dry fermentation," in which the char, well drained, but moist, and containing the fermenting agents already referred to, is removed from the cisterns, and allowed to lie in a heap for a week or two, or until all action has ceased. This process, how-

ever, involves a large amount of additional labour, and, as in the other case, keeps the char out of use longer than desirable.

2. *Dilute Hydric Chloride* has been used, in various ways and in all degrees of strength; and, for the removal of iron, perhaps no better agent can be employed. Sodic sulphite has been recommended to be used, along with hydric chloride, for the removal of iron; but the writer has not found the results of such treatment at all satisfactory. Hydric chloride must at all times be used with extreme caution; very dilute solutions should always be preferred, though the amount of lime or iron removed should be the smaller. The effect of any acid treatment is never perfectly satisfactory: the amount of impurity removed is generally less than anticipated; danger of injuring the structure of the char always exists; in whatever way the acid is applied, some of the char is certain to get more than its share, another portion getting less; while the entire removal of the acid from the char, after it has done its work, is difficult, if not impossible. Char, after having been treated with acid, washed, and re-burned, always shows an acid reaction—so difficult is the acid to wash out; and this residual acid has the effect of misleading the refiner when his sugar-liquor passes through the char for the first time. The liquor will look unusually bright, and light in colour; but colour due to the presence of traces of acid is valueless, as, in the process of boiling, it entirely disappears. Dr. Wallace, in his lecture to the Chemical Society, indicates that the colour of the sugar produced in such circumstances is superior, though the syrups are increased in quantity. This the author has not found to be the case; the syrups are increased, but the colour of the sugar is not improved.

3. *Gaseous Hydric Chloride.*—Mr. Beanes's process has already been referred to (Note VIII.) When the circumstances which obtain are such as to warrant its use, great care must be taken to have apparatus of the best construction, and thoroughly trained workmen to attend to the various operations involved. When the excess of lime has been removed, the process will, of course, be stopped until, by a sufficient increase of that impurity, it can again be used with safety and with profit. Dry gaseous hydric chloride

has no action upon the iron; so that, for the removal of that powerfully-injurious agent, it is inapplicable.

Various other acids have been used with a view to improve the quality of animal charcoal, but (unless in very special cases) with very discouraging results. Even carbonic dioxide has been used, forced into the char in the gaseous form under high pressure, under the impression that the calcic carbonate would be changed into dicarbonate, and thus rendered soluble. This may serve as an illustration of a rather numerous class of "inventions" the results of which are not only valueless, but in some cases most injurious. A case has come under the writer's notice, almost too absurd to be mentioned, in which undilute oil of vitriol was poured direct from the carboys upon the char in the cisterns. After the mixture had been allowed to act *a sufficient length of time*, it was dug out in blocks with picks! This process was conducted under chemical supervision!

The preservation of char in a state of efficiency is perhaps the most important problem in the sugar-refining industry; and certainly it were much better for the refiner to devote his best energies to the retention of his char in good condition, than to be compelled to adopt expensive, troublesome, and often questionable processes, with a view to restore qualities which, through careless working, have been lost. The question of char treatment is a most troublesome one; and, although almost every likely process has been practically tried, both on the large and small scale, by the author, the results have never given him unalloyed satisfaction. He is, therefore, the more desirous of impressing upon refiners the desirability of caring well for good char when they have got it.

A favourite "cure" for faulty char with some, is to mix in new or faultless char in various proportions; but, as must be self-evident to anyone who will carefully look at the subject, this is only to disguise the weakness of the old by the potency of the new. A char having a higher average quality will doubtless be the result of such admixture; but it is a mistake to suppose that the faulty char will thus be cured.

LECTURE ON SUGAR.

WE have pleasure in recording the delivery of another lecture of a popular character on sugar, given by Robert Blair, Esq., at Largs, N. B., on the 29th of March last.

The lecturer introduced his subject by rapidly passing in review the several kinds of sugar known to chemists, the various plants from which the cane sugar is obtained and the extent of the agriculture and commerce involved in the sugar industry of the world. The latter is well stated in the following paragraph:—

"It is probably near the truth to say that about three millions of tons of sugar are produced in the world annually. As a general rule an acre of canes produces a ton of sugar, so that we have about three millions of acres devoted to the growth of sugar, and about the same number of labourers are constantly engaged in its cultivation. Of the the three millions of tons produced probably two and a half millions are exported and furnish cargoes for about 7,500 ships. Or if we allow three voyages a year to each ship, or nearly so, the transport of sugar from countries of production to those of consumption employs constantly 2,500 ships and 40,000 seamen. And if we consider the thousands of men employed in the building, fitting out, and supplying these ships, as well as the thousands who obtain their livelihood in connection with the landing, warehousing, refining, and distributing of the sugar, we shall have some idea of the magnitude and industrial importance of the article."

The various modes of cultivating the cane and concentrating the juice were treated of, the open taches, the vacuum pan, and the Concretor being described, and the peculiar advantages or disadvantages of each pointed out. The different countries in which sugar is grown were alluded to, and the many systems of culture and manufacture were described at length. The subject was treated throughout in a lively and interesting manner, but the space at our disposal forbids a more extended notice or further extract from Mr. Blair's excellent lecture.

ON THE ACTION OF WATER AND OF DIFFERENT NEUTER SALINE SOLUTIONS ON CANE SUGAR.

By M. K. Clasen.

(*From the "Journal de Chemie Pratique.*")

The action of water and of saline solutions on cane sugar has often been studied. The results of the researches of Soubeiran, Berthelot, Maumené, and Béchamp, do not always accord. The work of the last of these is the most complete, and he concludes that if there is no development of mouldiness nor *micodenne* acting as fermentive principle, cane sugar is not subject to any transformation. Clasen has again taken up the subject. He employed a 10 per cent. sugar solution, and examined it by the saccharometer and by Fehling's liquid. To 100 grammes of the solution, 2 grammes of sulphate of lime are added, or the same equivalent of other salts. The experiments only lasted five days, because in that time vegetable mould was developed. The following are M. Clasen's conclusions:—

At the ordinary temperature pure water gradually transforms the sugar into glucose; in heating for some hours a solution immediately after preparation, it is not modified. Gypsum, sal ammoniac, and saltpetre prevent the formation of glucose, sulphate of magnesia weakens the action of the water. If a sugar solution containing gypsum, saltpetre, or sulphate of magnesia, which has been allowed to stand for some days, is subjected to a heat of 160° Faht. for some hours, a large quantity of glucose is produced. If a solution of sugar be heated with gypsum and sal ammoniac, the sal ammoniac is disengaged, and the liquid becomes acid. In all the other cases no acid reaction is observed, and molecular modification may be attributed to the action of the water only.

STEAM COMMUNICATION BETWEEN AUSTRALIA AND AMERICA.

The *Sydney Empire* says:—"A line of powerful steamers, combining speed with every comfort for passengers, having large roomy cabins with free ventilation, will connect the continent of America, calling at Honolulu, Fiji, New Caledonia, Brisbane, and Sydney. The route embracing all these places of call we have

indicated for adoption, for the sake of performing the whole voyage in fine tropical weather, and avoiding the stormy coast of New Zealand. The mails for New Zealand and Victoria will be conveyed thither by a branch line from Viti Levu, Fiji. A subsidy of £120,000 per annum will be required by the company, to enable them to lay on the line a class of steamers sufficiently powerful to maintain a rate of speed to accomplish the distance from Liverpool to Sydney in 49 days. Of this amount the American, French, and Hawaiian governments will contribute a part. The balance, not exceeding £75,000, would be required to be furnished by the Australian and New Zealand colonies. The advantages to these colonies from being in direct and rapid communication with all the places referred to, and their communication with Chili, at present interrupted by the breaking up of the Panama line, continued, is of sufficient importance, we presume, to warrant us in asking those colonists to entertain the subject, and to urge upon their respective governments the desirability of considering the matter. If, after due deliberation, we are notified of a view favourable to the proposed route, we will be prepared to enter upon the service four months after we receive such notification."

TELEGRAPHIC COMMUNICATION BETWEEN THE WEST INDIES AND SOUTH AMERICA.

The telegraphic line between Valparaiso and Buenos Ayres, across the Andes, will soon be erected. Messrs. Clark & Co., of Valparaiso, have succeeded in arranging this most important enterprise; the first portion of the line is now being shipped in London for Rosario. As the Panama, West India, and Pacific line will be extended to Peru, this will be united with the Transandine line from Valparaiso, and as the Argentine and Brazilian Governments have granted a concession for another cable to be laid from the coast of Brazil to the West Indies, there will be in a short time a direct communication with the whole of South America by two lines. The telegraph between Valparaiso and Buenos Ayres will be constructed entirely with iron poles and the best materials that can be obtained in England. The Argentine Government has granted a subsidy to this telegraph company of £6,000 a year, and that of Chili will add at least £2,000 more.

Correspondence.

The following correspondence which has been forwarded to us, though not intended for publication, will be interesting as showing that "*The Sugar Cane*" is penetrating into countries where the language in which it is printed is but little spoken.

Copy of a letter from a Sugar Planter in the North of Peru.

To Messrs. C. D. & Co., Callao.

Dear Sirs,

I am much obliged to you for the remittance of the new magazine, "*The Sugar Cane*," from the first number August to February. It is very interesting and more than all, a most instructive and useful monthly edition and will have a wide spread circulation among cane planters.

The circulation of the edition would be much greater if it could also be published in Spanish. At an early convenience I will write the results of the observations and experience which I have made the last thirteen years and remit the same to you. I should be glad to hear if my observations would tend to the advancement of the culture of the cane.

[Reply.]

Dear Sir,

In reply to your favour of 14th inst., it would afford us much pleasure to be the medium of communicating to the editors of "*The Sugar Cane*" the results of your valuable experience for the last thirteen years, in the culture of the sugar cane.

We are quite sure that such observations would be most welcomely received, not only by the proprietors but also by the readers of this magazine.

To the Editor of the Sugar Cane.

Lima, 27th March. 1870.

We shall be glad to receive some copies through Mr. Owen, of London, if published in Spanish; say 12 copies.

C., D. and Co.

We trust that the Peruvian sugar planter will not fail to favour us with the results of the observations he has made during the last thirteen years, as we are most in want of papers of this practical character.

With regard to the suggestion of the publication of a Spanish edition of the "*The Sugar Cane,*" whilst thanking our correspondents for their offer in connection with it, we fear we cannot see our way to such an undertaking at present.—*Ed. S. C.*

To the Editor of "The Sugar Cane."

London, April 4, 1870.

Sir,

When your circular came here last year, I was travelling on account of health, but have read ever since my return, all the numbers of "*The Sugar Cane*" to date.

I am glad to see that "*The Sugar Cane*" is favorable to every scientific improvement, and when almost every other industry has its special organ in the press, it is surely high time that the important manufacture of sugar should be no longer without one.

I observe with satisfaction, that questions relating to the agriculture of the cane are noticed by your journal, and I may, hereafter, trouble you with two or three letters upon that subject for insertion, if you approve of them.

Meanwhile, there is another question to which I should like to draw the attention of the readers of "*The Sugar Cane.*" Now, that slave trade to the British colonies has entirely ceased for upwards of half a century, and an admirable system of immigration of coolies from India, has been long since organized, surely it requires but little genius to follow such an example, in relation to the inhabitants of Africa.

In the first instance, coolie immigration (which has saved Guiana and Trinidad) was stoutly opposed by mis-informed and prejudiced men. It was, however, persevered in, improved from time to time, and is now a great success, and most advantageous to both parties. The system is, however, expensive, and I need not tell

you, that Africa is much nearer to the West Indies, and the people physically stronger than the Asiatics, and make excellent labourers; there can surely be no reason, therefore, why a system which has been found to work so well in the case of the Indian coolie, should not prove mutually advantageous in respect to the African negro and his employer.

I believe that intelligent West Indians would esteem a well regulated African immigration (and no other do I propose,) as one of the greatest benefits that could be applied to the cultivation of their estates. They want labour, but they do not want slavery; and are willing to pay fair wages for the labour which they hire, and need I say, that under such a system the African would possess many advantages, which he can never hope to obtain in his own country.

I am, Sir,

Your very obedient Servant,

A WEST INDIAN PLANTER.

To the Editor of "The Sugar Cane."

Sir,

In your number for March (p. 142), Dr. Phipson, speaking of cane trash, or megass, says, "Several of my correspondents have told me that cane trash is burnt, and that the ash is restored carefully to the soil in almost all the West India Islands, and in Demerara. Unfortunately, this cane trash is used as fuel, and we cannot expect to get work twice out of the same material. By burning the trash, its quality as manure is seriously deteriorated, the silica and the lime salts, which it contains in a soluble form, are thereby rendered insoluble, and more or less completely unavailable; its nitrogen is, of course, lost by combustion." And a few lines lower, "But it is burnt, it is used as fuel, and we cannot, as I have just said, expect to get work twice out of the same material." This seems to imply that cane trash—megass—by being burned as fuel is exhausted, and that the residue is next to worthless. It is to be hoped that no cane grower will in consequence cease to return his megass ashes to the soil from which they have been extracted. Doubtless prolonged subjection to intense heat would seriously

detract from the amount of matter soluble in water. The analyses of Dr. Angus Smith, F.R.S., given in "*The Sugar Cane,*" for Sept., 1869, Vol I., tend to prove this. That cane trash ashes are very far from being worthless, both his and Prof. Anderson's analyses most plainly show but the result following these, of an experiment made by Mr. Fryer, reveals the fact in a still more telling manner. If the grower can find other fuel to hand, and as cheap as cane trash or megass, it may be well for him to consider Dr. Phipson's proposition. No one can deny that when we have burnt cane trash we cannot use the ashes as fuel for a fire or furnace again. By burning we have obtained work from it, as Dr. Phipson remarks, but that work is only *a part, not the whole,* of its utility, an important fact to be remembered. The September number of your magazine above referred to has perhaps escaped Dr. Phipson's notice; this important question, "Megass as a manure," though shortly, appears more fairly dealt with therein, as well as since by Mr. A. Crum Ewing in your February number.

I am, Sir,

Yours truly,

GEO. MANLEY HOPWOOD.

Grosvenor Square, Manchester.

NEW PATENTS.—FROM THE MECHANICS' MAGAZINE.

A. SEYFERTH, Brunswick. *Purifying sugar and syrups.* Dated September 22, 1869.

The juices of sugar are worked directly in the vacuum pan either with a solution of sulphurous acid in water which does not contain more than 1 or $1\frac{1}{4}$ per cent. sulphurous acid or of the gas of sulphurous acid. The inventor mixes in the vacuum pan 100 parts of a concentrated solution of sugar of 28° to 42° Baumé, and 3 to 15 parts of a solution of sulphurous acid containing 100 parts of water of 1 to $1\frac{1}{2}$ parts gaseous sulphurous acid. He then thickens the mixture to the ordinary concentration of boiled sugar masses. During the evaporation the sulphurous acid is completely evaporated. The juices are improved in taste in a way which cannot be obtained by applying great quantities of animal charcoal. The disagreeable taste of the beet-roots is completely removed from solutions of beet-root sugar. The alkalies of beet-root sugar solutions and salts of coarse sugar containing alkalies are neutralized, and their noxious influence on the crystallization of the sugar is prevented.—Patent completed.

FOREIGN PATENTS.—FROM THE "SUCRERIE INDIGENE."

M. M. CRESPEL AND BOQUET, à Quesnoy-sur-Deûle (Nord.) *Method of treatment of fermented juice of molasses for the extraction of the raw salts of potash.*

The object of this patent is to increase the commercial value of the crude salts by transforming a large part of their sulphate of potash into carbonate of potash, the only substance of standard market value.

These crude salts contain, besides carbonate of potash and sulphate of potash, some chloride of potassium and carbonate of soda, some nitrates of potash and soda, also free sulphuric acid and other organic acids.

These last are eliminated by evaporation and calcination; but the sulphuric acid which has been added for fermentation, acts on the nitrates during these two operations, especially during the last, and transforms them into sulphates. It is this reaction which it is sought to avoid.

To effect this, immediately on the issuing of the boiling hot residues from the still, carbonate of baryta is added in sufficient quantity to neutralize the free sulphuric acid, and the acetic acid which is always produced in greater or less quantity during fermentation.

The disengagement of carbonic acid follows, and consequently brisk effervesence.

It is the carbonate of baryta, produced by the treatment of molasses with baryta, which should be employed.

When the operation is completed, that is to say, when there is no more carbonic acid disengaged, the liquor is made to pass through a series of decantating vessels in which the sulphate of baryta is deposited. The liquid which is left is then submitted to concentration and calcination.

The sulphate of baryta deposited is only of small value, but if it is thought desirable, in consequence of the high price of carbonate of baryta, to recompose it, the sulphate is allowed to remain some days exposed to the air, to remove the humidity and the impurities; it is then heated by wood charcoal in ovens submitted to a white heat, and it is thus transformed into sulphide of barium. Passing through a solution of this, a current of carbonic acid gas recomposes the carbonate of baryta.

The reaction on the residues of the carbonate of baryta employed is completed in the calcining oven. All the salts of baryta with organic acids, such as the acetates, are transformed at first into carbonates and then into sulphates. There is also a great enlargement of the incinerated mass, but this swelling is very advantageous in one respect, that it permits the carbonaceous parts to be more easily reached by combustion,

M. Icery, Island of Mauritius. *Apparatus for producing quickly and economically sulphurous acid and sulphites by the combustion of raw sulphur.*

The sulphur is burnt directly in the fire, the sulphurous acid produced is made to circulate in a vertical column, then in a horizontal tube to effect its refrigeration, then it is forced into a current of water proceeding in a contrary direction, which flows into a large lead-lined tub and the gassified water is then passed through vertical columns half filled with pumice stone saturated with water, and by these means are ensured the intimate contact of the water and the gas, and the complete solution of the latter.

This solution serves to prepare any sulphite whatever, by throwing it into an alkaline water; or sulphite may be prepared in the apparatus itself, if the water employed is alkaline instead of pure.

To produce sulphite of lime the sulphurous acid is mixed with finely powdered lime.

M. Martin. *Processes designed to purify and decolour raw sugars, and the molasses and syrups of factory or refinery.*

It is not sufficient, according to the patent, to remove from saccharine solutions their salts and other impurities; it is also necessary to eliminate the ulmine or ulmic acid which is the cause of their coloration.

This double aim is attained by the use of fluoride of aluminum. To effect this, the raw sugars, molasses, or syrups are diluted with a certain quantity of pure water to facilitate the action of the reagent, and there is added 2 or 3 per cent. of a solution of caustic potash in order to displace at once the colouring and viscous matters. Then fluoride of aluminum is added, and there is formed (1) hydrofluoaluminic acid, which with the bases, potash, soda, and lime form some of the hydrofluoaluminates which are precipitated; (2) the pure hydrate of alumina; which is precipitated in flakes removing at the same time the colouring matters already displaced.

The liquor is decanted after having some washed sand added to facilitate precipitation.

The clear liquor is afterwards heated in the usual manner, and very beautiful crystallizations and a large return of crystallizable sugar are obtained by the ordinary processes.

To prepare the fluoride of aluminum, put into a glass flask or a leaden vase one part of fluoride of calcium, one part of calcined anhydrous alumina, and seven or eight parts of concentrated sulphuric acid; then heat moderately.

For fluoride of aluminum, that of borax or of silicon, or other analagous chlorides may be substituted.

Fluoride of aluminum may also be employed for alcohol, ether, or petroleum, which dissolve it, and on which it will produce the same reactions and effects as on the saccharine substances.

European Beet-Root Sugar Crop for 1869-70, (calculated from the latest returns) compared with the two previous seasons, in thousands of tons.

	1869-70.	1868-9.	1867-8.
Zollverein	207	208	165
France	275	214	225
Austria	108	76	93
Russia	100	65	27
Belgium	45	37	31
Poland and Sweden	32	22	15
Holland	13	10	7
	780	632	634

Stocks of Raw Sugar in the Chief Markets of the World, in thousands of tons, to February 28th.

	1870.	1869.	1868.
United Kingdom	84	104	90
France	133	117	108
Holland	26	40	34
Zollverein	40	57	31
United States	73	14	6
Cuba	86	48	54
Total	442	380	323

Consumption of Sugar in Europe and in the United States, in thousands of tons, for the years ending 28th February.

	1870.	1869.	1868.
Europe	1303	1214	1174
United States (imported sugar)	413	452	372
	1716	1666	1546

SUGAR STATISTICS—GREAT BRITAIN.

To 16th April, 1870 and 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	12	2	1	2	17	13	14	3	1	6	24	24	11	1	1	4	18	44
British East India	13	2	..	..	15	10	3	..	..	..	4	7	4	1	..	..	6	6
Mauritius	6	..	1	2	8	4	6	..	5	3	13	12	3	..	6	1	10	15
Cuba	8	2	2	8	21	9	1	4	5	14	25	15	3	5	3	12	24	26
Porto Rico, &c. ..	1	3	..	1	5	2	..	3	..	1	4	2	1	2	..	1	4	5
Manilla, &c.	33	8	1	2	44	51	6	6	1	2	15	17	8	5	1	2	16	12
Brazil	..	10	1	4	15	15	..	15	2	7	24	20	..	12	2	5	20	26
Beetroot, &c.	5	1	1	3	11	4	12	5	3	13	33	19	9	5	3	14	30	18
Total, 1870 ..	78	30	7	22	136	108	42	36	18	45	142	116	40	32	16	39	127	150
Total, 1869 ..	68	28	3	9	28 increase		46	24	14	32	26 increase		55	33	15	48	23 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

As might be expected very little business was done in sugars in any of the British ports during the early part of the month, in fact to such an extent had the uncertainty regarding the duties paralysed trade for some time previously, that the transactions in the London market, during the first three months of the year, fell short of those of the same period of 1869 by 50,000 tons. In anticipation of a reduction of the duty, holders, of floating cargoes especially, were firm, there was no speculative demand by refiners or the trade, and of course as little as possible was bought for delivery.

The reduction in the duty has not had the effect which was anticipated, there has been no improvement in the value of raw sugar of any description, except of good grocery sorts, and low goods are in fact easier. The business done has not been large, considering the bareness of the stocks of the trade. Consumers are now enjoying the full benefit of the reduced duty, and there is no doubt but that that deliveries will eventually increase considerably, and as the trade get into stock the markets will gradually show more firmness, but we do not anticipate any material improvement in prices for some time, especially not in low sugars. The refined market is unsettled, the duty on foreign refined not having yet come into operation. Common refined lumps are quoted in London at 44/6 per cwt. Pieces and crushed have been in good demand, and prices have not yet declined to the extent of the reduction in the duty.

It is said that the drought in Mauritius and Reunion, as well as in Brazil, is likely injuriously to affect the coming crops in those sources of supply. From Cuba, too, it is thought that the usual large export cannot be looked for next season, as the long continued disturbances must reduce the extent of the cane cultivated, as well as render its manufacture precarious; on the other hand, there is no doubt the reduction in the English sugar duties will stimulate the growth of beet on the Continent of Europe, the sugar from which has this season been 150,000 tons in excess of last. The cultivation of the cane is also extending in many parts of the world, so that the contingencies affecting crops in particular parts will gradually have less effect on the general supply.

THE

SUGAR CANE.

REGISTERED FOR TRANSMISSION ABROAD.

No. 11. JUNE 1, 1870. Vol. II.

☞ The writers alone are responsible for their statements.

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PRACTICAL OBSERVATIONS ON CANE MANURE.—No. IV.

By Dr. T. L. Phipson, F.C.S., London,

Late of the University of Brussels, Member of the Chemical Society of Paris.

I have little doubt that the first paragraph of my last article will have shocked many of my readers. They will only have experienced what I myself have felt, still more keenly perhaps, after following up the results of agricultural researches in recent times. It must not be thought that in expressing an opinion upon the very limited extent of our theoretical knowledge, I do not thoroughly appreciate the labours of the eminent men whom I have mentioned, and of those who are now following boldly in their track. No one admires more than I do these indefatigable researches, nor can better appreciate their value to mankind at large.

And why do we meet with such conflicting evidence in the results published within the last 40 or 50 years by the most eminent philosophers and men well accustomed to observe? Why these interminable discussions? How is it that we have yet no fixed rules to govern our actions, and to ensure us in every case the highest degree of fertility in our soils?

It is simply because we are dealing here with the *life* of the plant, and the phenomena of life are mysteries which no one can solve.

We find all plants formed of certain elements (four in number), carbon, hydrogen, oxygen, and nitrogen, and a small quantity of

mineral matter amounting at most perhaps to 4 or 5 per cent. of the entire plant. Three questions present themselves naturally to an enquiring mind:—1. Where do each of these substances come from? 2. How do they get into the growing plant? 3. What do they do when they get in? In the present state of science *none* of these questions can be answered in a satisfactory manner! So much for physiological chemistry, a branch of science which is almost unknown to the greater number of our modern chemists, and which, dealing with the chemical phenomena characteristic of life, is of the highest importance to us.

Some philosophers have told us that most of these substances are derived from the soil; others, that they are almost entirely taken from the air—that "vegetables are beings spun out of the air by the rays of the sun"—and others, again, falling between the two extremes, admit that they are derived partly from the air and partly from the soil.

So also we have various theories as to the manner in which these substances get into the plant. Some say by simple imbibition as water soaks into blotting paper, by endosemosis, by chemical decomposition, by the dissolving action of certain acids secreted by the roots, or again, as vapours taken in by the pores of the leaves.

The two first questions being answered yet in so undecided a manner, it seems natural enough that the third should be still in perfect obscurity, or nearly so. But in reality, modern organic chemistry has taught us a great deal about what goes on in the cells of a plant, and it has even shown us how to imitate nature in producing various organic substances artificially: so that, this third question which should be, apparently, the least known has actually been answered better than the others!

Hydrogen and nitrogen are absorbed, according to Cloëz,* in the shape of water and nitric acid (combined with some base) and ammonia is likewise taken up in the shape of nitrates, into which

* *Considerations générales sur le rôle des Nitrates dans la Vegetation*, par M. S. Cloëz, Membre de la Société Chimique de Paris. A Lecture delivered before the Chemical Society of Paris on the 18th March, 1861. Paris: Hachette, 1862.

it is transformed in the soil. Carbon is absorbed as carbonic acid (or carbonates) only, according to the majority of chemists, and oxygen is derived from all these sources, and also from the air. As to the mineral matters of plants they appear to be taken up in various forms, mostly as soluble salts, or salts rendered soluble by the action of the plant upon the soil.

In this somewhat uncertain state of things we must allow ourselves to be guided by direct experiments independently of any theory; such for instance as those remarkable trials made by Prof. Polstorff † in which he found that of all manures known that derived from the excrete of animals gave by far the highest results. All who have devoted their time to this subject are of opinion that rich, well prepared farmyard manure is the most perfect manure known. This is the case doubtless, because it contains all the ingredients that a plant can require, because its action is certain, because it gives up these ingredients in the proper state, in a readily assimilable form; and the more closely any artificial product approaches to the composition and properties of good farmyard manure the more valuable is the action of such a manure upon the land.

But farmyard manure has one great drawback: it contains an enormous amount of water—70 to 80 per cent. of its weight—hence it can only be used on the spot where it is produced; carriage to any distance is out of the question. Within the last few years, however, a product has been obtained from excrete at Bloxwitch, in Staffordshire, which may be well compared, by its composition and fertilizing properties, to concentrated farmyard manure. It is got by evaporating the excrete of large towns, as nearly as possible to the dry state, and forms, I believe, the most perfect manure actually known—that indeed which nature evidently intended for our use. Instead of containing 70 to 80 per cent. of water it contains only 12 to 14 per cent., therefore its transportation to considerable distances can be effected as with guano. Upon analysis it is shown to contain all the ingredients of rich farmyard manure, in a concentrated state, and in the same assimilable form.

† Polstorff, Annalen der Chemie, lxii. p. 180. (1847).

Some costly apparatus have been erected at Bloxwitch and Churchbridge in order to get this valuable product, and specimens of it have been submitted to the Royal Horticultural Society of London, the superintendents of whose gardens experimented with it during the years 1868 and 1869, and to myself. The former have now drawn up an official report, sanctioned by the Council of the Society, upon its effects. This report coincides completely with the results of my own experience on a smaller scale, and both confirm once more the older experiments of Professor Polstorff, made in 1847.

Nothing can be easier than to combine the properties of so perfect a manure with the art of restoring a partially exhausted soil. When the latter has been found by analysis, to be deficient in lime, potash, or phosphates, for instance, these substances can be added without increasing its cost, and thereby supplied to the soil in rather larger quantities.*

With regard to a letter by Mr. Hopwood, in the last number of the "*Sugar Cane*" about cane trash. If megass is completely burnt the only substance it can supply directly is potash. But cane soils generally lose their lime before the potash is all gone. I would also refer to Boussingault's experiment on the action of the ash of farmyard manure, alluded to in my first paper.

The best way to utilise megass would be to mix it, weight for weight, with superphosphate. It would very advantageously take the place of chloride of potassium in the mixture recommended by my learned friend Dr. Anderson, (superphosphate, sulphate of ammonia, and muriate of potash,) and considerably diminish its cost. This would be better than treating it with acid, as suggested by a Jamaica correspondent in the "*Sugar Cane*," for April last, p. 237. When I have a little more leisure, I will refer again to this subject.

Analytical Laboratory, Putney, S. W.

* I believe the product in question can be made at such a cost as to be delivered in the London Docks at about eight guineas per ton. I have already recommended some trials to be made with it in the islands and in Demerara, where, I have very little doubt it will soon be largely used.

THE CANE DISEASE IN THE ISLAND OF REUNION.

FOR some years past the islands of Reunion and Mauritius have suffered greatly from a disease in the cane, which in many parts was developed to such an extent as to threaten the planters and proprietors with ruin. In Mauritius, as is well known, amongst various methods for overcoming the evil which are now being carried out, the cultivation of species of cane new to the island, imported from Egypt, Queensland, and other parts, is now being tried; and whether it prove successful in eradicating the disease or not, there is no doubt but that great benefit will accrue therefrom.

In the island of Reunion a commission was appointed by the Chamber of Agriculture, charged to enquire into the culture as well as into the disease of the cane, as it was thought (very reasonably) that the disease might spring from faults in the method of culture.

The report of the commission is now before us, forming a considerable part of the "*Proceedings of the Chamber of Agriculture, for* 1869." We need make no apology for bringing this report before our readers, for although the circumstances and the mode of culture in Reunion are in some respects exceptional, yet there are many colonies in which the physical conditions do not widely differ, so that much of the report may be of interest in other parts of the sugar growing world.

The report itself is too voluminous and too discursive for literal reproduction, we therefore summarise the translation of those parts of it, likely to be the most generally interesting.

In attempting to define the nature and causes of the disease in the cane, the report goes back to the defective systems of culture which have been practised in the island for a long period, and finds in the loss which the soil has sustained by the debris and refuse of the cane not having been returned to it, and in the notorious insufficiency of the manure applied, as well as the eminently vicious mode of applying it generally adopted, and in the continuous culture of the same plant on the same soil, the conditions

which have resulted in the impoverishment of the soil and the malady of the cane. It also insists on the bad effects which have been produced by guano improperly applied, and asserts that in all countries this powerful but incomplete manure, forcing the plant to consume in one or two crops the reserve of nutriment which the soil should not have given up for many years, has often left an estate after an abundant crop, so exhausted as to be powerless to nourish any other: and that this impoverishment of the soil (which is generally admitted in the island,) preventing the complete nutrition of the cane, has resulted in the lowering of the vital energy of the plant and in the degeneracy of the species. In proof of this, reference is made to some analyses of the ashes of sound and diseased canes, which show that in the latter there is a considerable deficiency in the proportion of some of those substances which experiment has shown to be indispensable to the vigour of the plant, and also the most easily exhausted from arable land, viz.: the phosphates and the potass. It is asserted as a law that nature gives up to parasitics, with a view to its destruction, everything which is dead, dying, or even only simply disturbed in its vital organism, and to the carrying out of this law is traced the number of parasites, animal and vegetable, to which the diseased cane is subject; with the exception of two species of moths accidentally introduced from abroad. Thus, we have gradual impoverishment of the soil from improvident practices, sudden exhaustion in consequence of undue development of the cane by means of guano (incomplete without farm yard manure in addition); and thence insufficient nutrition, lowered vitality, and degeneracy of the plant which is impressed on all the cuttings, and which the richness of the better soils cannot overcome; as a fatal consequence the over running of the cane by innumerable parasites ensues. Such in the opinion of the Commission is the chain of events leading to the then actual state of the cane in the island.

Some exception has been taken to this, founded on the fact that the disease has appeared on plantations where the soil has not been exhausted by the injudicious use of guano, but it is found that

on these exceptional estates the system of culture has been vicious in other respects, and that wherever the parasites have appeared it has been where the soil is impoverished and the cane miserably nourished.

It appears to have been a not uncommon opinion in the island, that the whole question turned on the use of suitable manures, chemical or other, but the report takes a much more comprehensive view of the subject, and considers that the manures of commerce though valuable, are yet exceptional; and that the manner of preparing the soil, the preservation of local manures and their mode of application, the growing of green manures, and the rotation of crops are of much greater importance than the use of chemical manures, though these may be of great value in certain cases. The report then passes in review the principal operations of the culture beginning with:—

THE PREPARATION OF THE SOIL.—In Reunion the cane is usually planted in the rectangular hole (trou), introduced by M. Debassyns from the sugar colonies of the Western hemisphere. The advantages of the hole are these:—That when the cutting deposited in the bottom begins to vegetate, the covering of soil can be readily proportioned to its wants; that it permits the cane stool the better to develope lateral roots, gives it stability to resist the wind, and provides it with a large radius for obtaining nourishment; but these advantages are, it appears, only realised in land rich throughout, and sufficiently permeable; otherwise the method is of questionable utility; and when the roots of the plants cannot readily traverse the walls of the hole the space is too confined, and they cannot obtain sufficient nutriment. From various reasons given at considerable length the report decides that except on rich lands the hole does not answer the end intended, and that the method of manuring where the hole is used, which consists in depositing the farm or other manure at the bottom of the hole aggravates the evil, as by this method the soil round the hole is never manured, and it is from the soil round about (where the roots spread) that the nutriment of the plant is derived, thus it is only by accident, by heavy rains for instance, which cause the manures to

spread to some extent, that the cane will be properly developed, but that in case of drought the crop is likely to perish. It is necessary then to discover some means whereby the advantages of deep planting may be retained, and the evils of the present system of spreading the manure remedied. As regards the preparation of the soil, an important consideration and one which the "report" considers has been much neglected in Reunion is:—

Tillage.—The true aim of which as applied to the cultivation of the soil has been misunderstood. It is generally supposed that the furrowing the land with the plough promotes the chemical improvement of the soil by exposing the lower parts to the air and sun; but this, though correct enough in temperate climates where the old adage that tillage is good manure obtains, is not to be taken as proved in hot climates; nay, the best authors on tropical agriculture carefully guard against this assumption, and in fact recommend that deep ploughing should not be resorted to for fear of disastrous results. It is then, says the report, a mistake to regard tillage in itself as capable of fertilising the soil, or as an equivalent for manure; and much damage has been done by misconception on this head, thus, instead of commencing by surface ploughing and gradually going a little deeper year by year, the soil has been recklessly turned up to a depth of 18 or 20 inches, and then the planting of the cane immediately proceeded with.

An instance is cited of the mischievous effects of deep ploughing on the estate of St. Benoit, which was at one time of admirable fecundity, and six years ago produced most fruitful crops, but was about that period turned up to a depth of 20 inches since which time it has been almost sterile, and is only now very slowly regaining its former agricultural value.

Tillage then should be considered less with a view to improving the chemical qualities of the soil than as a means of gradually mellowing it, and especially as the only economical method of properly spreading the manure. This the report considers as an operation of the first importance, and one which has unfortunately heretofore been conducted in a very defective manner in Reunion. It goes on to say how important it is that the cane roots should be

able to find sufficient nutriment at all periods of their growth and in all parts of their course, thus whilst the roots spread a metre or so beyond the walls of the hole (and botanists have shown that they absorb nutriment exclusively by their extremities) the manure is confined to the bottom of the hole, the result being that the plant is deprived of nourishment just at the time when it is most fully grown, most vigorous and most in need of it; consequently this is the period when the cane most frequently droops and languishes.

As regards the spreading of manures the report considers separately the powdered or artificial manures, the straw or farm manures, and the green crop manures. Respecting the first it quotes what M. G. Ville (a French manure manufacturer) says about compost, on the homogeneousness of which he particularly insists. "In order that a manure should penetrate well, and be able to produce all its effect, it is needful that each filament of the root should be able to absorb at the same time all the products which enter into its composition. * * When we consider that the proper spreading of the manure makes a difference of two or three bushels of grain per acre, we see how important it is to execute it properly; when machines for spreading are not available, and the manure has to be spread by hand, it is best to mix it with its own bulk of dry earth and to sow it broadcast. In the cultivation of grasses, peas, or beans, the manure should be spread after the last ploughing, and its subdivision over the superficial beds of the soil completed by vigorous harrowing." "For tap-rooted plants which bury their fibres to a considerable depth it is better to spread the manure at twice, the first half after the first ploughing, the rest after the second." As regards the manure for the cane, the report recommends that only part of it should be put in the trench or hole, and the rest round about it, and that the manure should be applied on or before planting the cane; the latter is considered important, experience having shown that manures applied some months after planting are a long time in producing effects, or even remain altogether inefficacious, whilst excellent results have been shown on estates where the canes have been manured on planting. It certainly appears reasonable that being well nourished during the

first period of its growth the young plant should acquire a *vigour* which it would not otherwise reach. As regards manuring, the method recommended as the best is to spread the manure equally over the surface of the soil and then to plough it in. Some planters it is stated have practised a method which, though not so good, has yet produced good results. It is to dig a trench between the rows of canes and to fill it with manure. The spreading is less complete, but there is formed at a short distance from the cane plant a rich deposit from which the roots can draw abundant nutriment and spread about easily; for it is a singular phenomenon which has been characterised as the instinct of vegetation that plants possess the faculty of directing their roots to those parts of the soil where nutriment is to be found, so that when the soil is not exhausted and the plants are vigorous this practice of trench manuring is sufficient, and it has the advantage of being easily carried out, and in this way the trash and other debris of the cane, also green manures, are best applied. As regards the utility of trash or megass; starting on the recognised agricultural maxim that each plant is to itself its manure *par excellence*, the report strongly insists on the policy of applying the megass or trash in its green state as far as possible; in support of this view it cites the author of what is designated as "the best book which has been written on the culture of the cane," L. Wray, who goes so far as to say that if the whole of the residues of the cane after the extraction of the sugar were returned to the soil in their fresh state, that the cane might be cultivated on the same land for an indefinite period. The report quotes at length Mr. L. Wray's opinion of using the megass as fuel, of which practice he was the inveterate enemy.* On the use and utility of green crops as manure

* "Using the cane-trash as fuel is the most unwise and suicidal practice I can imagine; and I believe no planter will continue such a system who can possibly obtain a supply of wood or coal. It has just been estimated that 6600 lbs. of coal will serve to grind off canes sufficient to produce 5600 gallons of juice and to evaporate the same so as to yield 5600 lbs. of sugar: which is at the rate of 2640 lbs. of coal required to each ton of sugar manufactured. Now coal can be landed in the West India colonies at £1 sterling

the report is especially full, complete, and emphatic; it accuses the promoters of chemical manures exclusively, of losing sight of the mineral elements which enter into the composition of plants, and of forgetting that they need other things for life, water for instance; thus, as an example, M. Ville in the analysis of a green manure containing 1·48 per cent. of nutritive matter, inscribes as comment these words, "water 80 per cent., *of no utility to the plant*." Strong prejudice, says the report, was shown in the writing of these words, for when during a long period of drought it is impossible to irrigate a field supplied with chemical manure, this manure will remain inert, thus some of the 80 per cent. of water contained in the green crop manure buried in the soil is not so entirely useless as the learned professor states. In dry countries, this water of composition is of great utility, for the farm and green crop manures which decompose within the earth form a sort of sponge which restores to the soil the moisture which the soil gives up to the plants whose alimentary principles it holds in solution. In this way green manures are of value beyond the nutritive principles they contain. Sufficient importance, the report goes on to say, has not been attached to the eminently fertilising power which the soil acquires from the alternate culture of a leguminous with a graminaceous plant. The leguminous plants have the power of drawing from the atmosphere a large proportion of nitrogen, which they afterwards give up to the soil, and their tap-roots bring from the interior to the surface some of the potass, phosphates or other salts useful to graminaceous plants.

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per ton; so that an estate making 250 tons of sugar can obtain sufficient of this fuel to manufacture the same for the small sum of £290 sterling."

"Supposing an estate to be situated within anything like a moderate distance from the port, the expense of carting the coal from the wharf would certainly not be equal to the expense of drying cane trash, stacking or housing it, and finally digging and carrying the same when wanted to the "stockhole." Independent of which there would be no stopping the manufacture for want of fuel, perhaps at the very time when expedition is required, when every moment is precious; there could then be no fear of fire catching the trash in the yard, or in the houses, and thus burning down "the works" and perhaps the whole estate, as has frequently happened in Jamaica."

However, this may be, it is certain that leguminous crops, used as green manures, have fertilised certain soils on which the best artificial manures have remained impotent. According to Fullenberg this system of manuring suits a soil which has been exhausted by artificial cropping; in such soils when ordinary manures are often insufficient the ploughing or digging in of green crops is of the greatest efficacy.

It is related on the authority of M. Bella, senr., that when he took the direction of the model farm of Grignon, he found near the Chateau some fields of good quality, but which had been so exhausted by continuous culture that even with double manuring they would scarcely yield a passable crop. He sowed these fields twice with Sarrazin which he ploughed in when in flower. This cost only one-third of an ordinary manuring, and produced an excellent crop of corn.

But, the report continues, the importance of ploughing in must not be lost sight of, the actual usage, which is either to remove the green crop from the soil, or leave it to dry on the surface, must be renounced at once, the least reflection will show that by either of these modes of proceeding the greater part of the benefit of green crop manures is lost.

The leguminous plants used in Reunion for green crop manures are chiefly the Mascat pea (Mucuna Utilis), the Bitter pea (Phaseobus), the Ambrivetto (Musk Mallow?) (Cajanus Indicus), the Cassava pea, a shrub called White Indigo, and another leguminous plant of which the name is not known; these all flower during April and May, when they should be ploughed into the soil, as at the period of flowering all plants contain the most nutriment. The ploughing in of the peas in May is in one sense inconvenient, as it leaves the soil bare until the period of planting of the cane, and thus free to weeds and open to the sun. To counteract this it is recommended that some other quick growing plant should be sown immediately, and the double advantage secured of covering the soil, and having another crop of green manure. The Indigo plant (Indigofera Tinctoria) has been suggested and is strongly recommended as green manure by L. Wray, but the report

mentions two other plants in preference:—1st, the Sarrazin (a kind of Birthwort) (Fagopyrum Esculentum) which will grow in Reunion at any period of the year; the other is the White Lupin (Lupinus Albus), the most powerful of European green manures, which has been cultivated as such from remote antiquity, and which on the most sterile soils in the south of Europe is very effective. As the White Lupin is not indigenous to Reunion, the Chamber of Agriculture is recommended to grant a subsidy for the importation of a quantity of seed in order that this plant may be tried in the island.

The report strongly insists on the advisability of substituting some other mode of planting the cane for the square hole generally practised, and appeals to agricultural machinists to invent or suggest some horse machine which will be capable of making a trench having the advantages of the hole without its defects, and thus also saving the enormous expense attendant on the labour of hoe culture.

The conclusions arrived at by the Commission are thus summed up:—

"1st. The cane disease presents complex phenomena, resulting from a combination of causes of a physical, physiological, hereditary, and parasitic nature, of which the connection will probably always remain obscure.

A The physiological cause is a want of nutriment due to the exhaustion of the soil of certain elements from insufficient restitution, and also from the inability of the cane roots to derive benefit from manure applied in an essentially defective manner.

B The physical causes are the result of unfavourable meteorological circumstances, chiefly to the drought and the want of irrigation, which are doubly unfavourable, inasmuch as the plant is deprived of moisture, and the spreading of the manure which is dependent on rain cannot take place.

C The hereditary cause is the debility communicated to the plant by the stock where already diseased, or from having in consequence of incomplete nutrition, acquired what Professor Bouchardt calls *la misere physiologique.*

D The parasitic cause is well known, it consists partly in the fearful scourge introduced from abroad, and in the development of innumerable macrophytes and gallinsects provoked by the organic decline of the cane itself.

2nd. The multiplicity of these causes, aggravated reciprocally, shows the necessity of not limiting our efforts to the eradication of one to the neglect of the others. Thus, if we see the necessity of returning to the soil, all the elements of nutrition of which it is deprived by the cane, we must not forget that it is indispensable to spread these elements so that the roots of the plant are able to absorb them. Then again, the preparation of the soil is not of less importance than the nature of the manure. Into this last we should have been glad to have gone at greater length, to have pointed out the remarkable effects of molasses as a fertiliser, the the utility of liming, and the enormous benefits of irrigation; but the field of investigation is too extensive for one generation to exhaust."

THE INCREASE IN THE CULTURE OF THE BEET ROOT IN EUROPE.

From the Journal des Fabricants.

The culture of the beet root is extending both in France and in the northern part of Europe as is evidenced by the erection this year of the 89 new factories which are now in progress of construction. Never have the plough, the extirpator, the roller, and other agricultural implements prepared a greater breadth of soil for the precious saccharine root, and never were mechanical workshops busier preparing stocks of tools in which iron and copper enter so largely into construction. From Paris to Lille, from Brussells to St. Petersburg the greatest activity prevails in the factories of the manufacturers of special machinery, who excite envy by plans of immense *usines* and by the construction of machinery of vast proportions.

The large apparatus at D'Ongny St. Benoite is surpassed, and we may form an idea of the progress which has been made in two

years in the presence of the crystallizing pan of Meux which may now be seen in the workshops of the quay de Grennelle. Our workmen have become gradually accustomed to these colossal dimensions, which do not cause them any surprise, but which testify to the public the practical character of the new industry and the great development which it daily exhibits, a development which, from a commercial point of view, suggests several considerations.

Fifteen new factories we are assured are in course of erection in France alone, and we may presume that our production for the next season may be estimated at from 325,000 to 350,000 tons. The consumption being 275,000 tons yearly, and the exportation of raw, and refined reduced to raw 150,000 tons, makes a total of 425,000 tons; there is still room for 75,000 to 100,000 tons to be supplied by importation from our colonies which last year sent 82,000 tons. With the production of the next season capable with a good crop of greatly exceeding the figures above named, we may then say that the importation of foreign sugar into France is unnecessary, and that our refiners and proprietors will have little or no trouble in being able to supply the wants of the interior very abundantly, and to respond to all demands made upon them. France will thus have realised the ideal of a national production sufficient for herself, and will be able also to enter into an export trade in which in the midst of many able competitors she will occupy the first rank, which export trade is now more than ever the safety valve of indigenous production.

One of the "several considerations" suggested by the above, is, the possibility of the culture of the beet root being carried to excess, especially in France, where the land appropriated to it must be withdrawn from the culture of some other crop of perhaps greater importance to the country if not more profitable to the grower. Then, too, the attention which is now being so generally directed towards improved modes of culture and manufacture of cane sugar must eventually tend to reduce the profit on *beet*, especially as the natural advantages are nearly all in favour of the cane.—*Ed. S. C.*

ON THE ABSORPTION OF DIFFERENT SALINE COMBINATIONS BY ANIMAL CHARCOAL.

By M. Bodenbender.

The action of animal charcoal on solutions of different salts has already been frequently the object of analytical research. Notwithstanding these anterior works that of Dr. Bodenbender will contribute to clear the important question of the absorption which goes on in the filters.

The animal charcoal employed was of average grain and had been treated with a little diluted hydrochloric acid, to eliminate the alkaline carbonates, and afterwards carefully washed. It contained then 5·69 per cent. of carbonate of lime, 8·29 per cent. of carbon and 0·12 per cent. of sulphite of lime.

Three solutions of each salt had been prepared at different degrees of concentration, a fourth contained some sugar, which was added with a view of determining whether the absorption was modified by the presence of this body.

The author describes in extenso the manner of operating and the results obtained by chemical analysis which he also unites in a synoptical table and presents in that form. We are only able to reproduce here a *resumé* of the conclusions to which his researches led him.

1. The capacity which granular animal charcoal possesses of absorbing salts and their solutions is for the most part a physical property.

2. One part in weight of charcoal absorbs a larger proportion of salts from a concentrated than from a diluted solution; on the other side the proportion absorbed from a constant quantity of salts is more considerable when this quantity is more diluted than when it is in a concentrated solution.

3. The presence of sugar has only a slight influence on the absorption.

4. The salts of potass are absorbed in smaller proportion than the salts of soda.

5. The absorption of salts varies according to their composition; it increases in the order of the following list of salts submitted to experiment, being the smallest in the first on the list:—

Chloride of Potassium.
Chloride of Sodium.
Nitrate of Potash.
Nitrate of Soda.
Acetate of Potash.
Acetate of Soda.
Sulphate of Potash.
Sulphate of Soda.
Sulphate of Magnesia.
Carbonate of Potash.
Carbonate of Soda.
Phosphate of Soda.

6. A chemical action of the charcoal has been observed with respect to some carbonates, oxalates, and alkaline nitrates; it is determined by the presence of sulphate and of phosphate of lime in the charcoal.

7. Charcoal saturated with a certain salt is still able to absorb another salt from solution, nevertheless this action takes place within certain limits.

8. There is less absorption from a salt when in contact with the char for a short time than when the contact is prolonged. The difference, however, ceases when the contact has lasted some hours.

SUGAR USED FOR BREWING IN THE UNITED KINGDOM.

An Inland Revenue return shows that in the year ending September 30, 1869, 41,980,949 lbs. of sugar were consumed in breweries: 20,939,791 lbs. in London, 18,194,001 lbs. in the provinces of England, 625,529 lbs. in Scotland, 2,221,628 lbs. in Ireland. The total is above 4,000,000 lbs. greater than in the preceding year; the quantity used in the provinces in England increased from 12,290,578 lbs. to 18,194,001 lbs.

THE SUCTION FAN APPLIED TO THE CONCENTRATION OF SACCHARINE JUICES.

By V. Frappier de Montbenoit.

The concentration of the juice is the most important operation in the manufacture of sugar in the colonies; under the influence of certain substances which it contains, the cane juice may be spoilt in a few minutes, and the successive modifications which it afterwards undergoes only renders it more likely to yield produce difficult of extraction and of inferior quality.

Heat affords, it is true, an efficacious means of paralysing the action of the agents of fermentation; but the elevation of temperature in the sugar wort is in itself a powerful cause of injury to it when it passes a limit which it is almost impossible to avoid overstepping with the apparatus now in use.

To concentrate with rapidity, and to crystallize with the least possible elevation of temperature, are the principal conditions to be realised in the treatment of the juice. The efforts of the colonial sugar industry, although unceasingly directed to this end, have as yet only achieved some slight improvements in the manufacture of sugar. The triple effect, and the vacuum pan, are but little used in the ordinary practice of the sugar industry in Réunion, the greater part of our factories continue to work as for long past with the Gimard battery and the Wetzell pan.

Whatever may be the services which these processes have rendered, their insufficiency cannot be denied, and their acknowledged imperfections urgently demand a remedy. The battery has not only the defect of requiring the burning of megass to the detriment of the soil, but it is to its action that the production of a large quantity of molasses must be attributed. We know for a fact that molasses does not exist naturally in the juice,* that it is formed only during the process of concentration, and that heat is the generating cause.

Now the battery acted on by the naked fire with a combustible of which it is impossible to regulate the action, is under conditions the least likely to prevent this unfavourable result.

* It has been clearly proved that uncrystallizable sugar is *always* present in cane juice to some extent, sometimes in large quantity.—*Ed. S. C.*

Having personally repeated the experiment made by M. Devosne at Havana, we have obtained sugar, if not perfectly crystallized at least of very good colour and apparently without any trace of molasses from a certain quantity of cane juice by merely exposing it to the sun's rays on a day when there was a strong wind.

It is in the Wetzell pan that the evaporation, commenced in the battery, is completed. Applied in such a way as to permit of the use of the waste steam, and offering thus the facility of removing the syrups at the point of concentration from the influence of the naked fire, this process constitutes a real improvement from the double point of view of economy and of improved quality in the produce.

The object of the rotator, the essential part of the system, is to accelerate the vaporization by the assistance of the air. But this apparatus is not free from faults, the hemispherical form of the bottom of the pan must be unfavourable to the equal distribution of the heat through the body of a liquid, the consistency of which varies in all it parts.

The usual method of placing these pans, which renders them dependent one on another, their steam pipes being connected, is equally defective, because it often happens that between the emptying and refilling of one pan a sufficient time elapses for the steam which does not cease to circulate, to caramelise the layer of syrup which adheres to the tubes, a circumstance which must necessarily be prejudicial to the succeeding operations. Besides, the rotator in its present form at least, by the agitation it keeps up in the syrup when the concentration is nearly completed especially, must be prejudicial to the crystallization of the sugar.

In a word, although the Wetzell pan represents a true and pregnant idea, we cannot but admit that the idea is as yet incompletely carried out. This idea, the application of which in the colonial manufacture will always be more easy and less costly than any other, we propose to realize under another form.

We will briefly recapitulate the principles on which our process is based by way of introduction.

1st.—All liquids whatever their temperature will evaporate in the open air.

2nd.—The evaporation is slower when there is no motion in the air, the presence of vapour already formed is an obstacle to the diffusion of vapour in the process of formation.

3rd.—The evaporation is the more active in proportion as the surface of the liquid is greater, the air dry and rapidly renewed.

"A dry wind blowing very strongly over the surface of a lake would produce in it," says M. Pouillet, "an evaporation quite as rapid as would be produced in an absolute vacuum, because the molecules of vapour would be carried off so quickly that they would not be able to exercise any pressure on the molecules of water so as to prevent them vapourising in their turn."

There is great difference between our practice and the method which these theoretical facts point to as the true one. The processes carried out in nearly all our factories are completely opposed to these elementary principles. In fact our methods seem merely calculated to provoke the formation of molasses, and the caramelization of the sugar, and both the battery and the Wetzell pan hold a quantity of liquid much too great in proportion to their evaporating surface.

The almost entire want of ventilation in our factory buildings is especially to be regretted, for as a consequence the air is saturated with steam to such an extent as to render the proper *surveillance* of the operations almost impossible.

The application of the suction fan to properly formed evaporators would remedy nearly all these disadvantageous conditions.

The theory of the suction fan being well known we need not reproduce it here; the form and dimensions which it may be convenient to give it to accord with its special destination may be the object of a future note, which will also contain a detailed account of other parts of our apparatus.

Suffice it to say for the present that the concentration and crystallization is effected on juice coming direct from the defecators, in one operation, in closed pans flat in shape, of very slight depth, and heated by steam. In the covering of each pan there are two

principal openings, the one connected with the suction tube of the fan, the other which may be closed at will is intended for the introduction of a current of dry air, the strength of which will depend on the rapidity of the motion of the volutes of the fan by which the steam will be carried off as fast as it is formed, which the operator can render as rapid as he pleases.

Thus is realised as far as possible in actual manufacture the conditions prescribed by the principles enunciated above.

In addition the steam may be easily collected and condensed, and thus will form a useful provision in many localities where the scarcity of water is often the cause of prolonged interruptions in the work of manufacture.

Without pretending by the installation of this simple process to have arrived at once at results which leave nothing to be desired, we are quite satisfied that it will at least produce a larger return of sugar (of equal quality) than what is obtained by the use of the battery and the Wetzell pan.

It is important to know, further, whether the use of the apparatus will in other respects conduce to the realization of a higher profit on his sugar than is usually obtained by the planter; of this practical experience alone will enable us to decide definitely.

NEW SYSTEM OF CENTRAL SUGAR FACTORIES IN FRANCE.

By M. Payen,

*Of the Academy of Sciences, perpetual Secretary of the Society of Agriculture in France.**

M. Linard, sugar manufacturer, formerly constructing engineer to the house of Cail & Co., has had the ingenuity to invent a plan for conducting the juice of the beet to the central factories through underground pipes instead of transporting the roots on heavy carts.

* Report presented to the Central Society of Agriculture in France, adopted in the sitting of the 20th April, 1870.

In the year 1867 he communicated to the Society of Agriculture the first results of the practical realization of this idea. From that time we have watched with interest the progress of an innovation which may effect a happy revolution in one of our largest agricultural industries. Experience has justified the hopes then entertained of this bold project.

The first application of the new system was made by the usine of Montcornet, in the department of l'Aisne, in which a length of five miles of tubes were laid down. The next application, equally successful, was at the usine of Vauciennes (Oise), with six miles and a quarter of tubes. The excellent results obtained in these places showed the advantage of suppressing the double transport of the roots to the usines and the pulp back to the farms.

Fifteen rasping houses, with simple apparatus for the extraction of the juice have been worked with success during the last season, being connected with their central factories by a total of about 70 miles of underground tubes. By next season fifty rasping houses will be erected, using above 220 miles of tubes.

With this ingenious method of supplying the sugar factories important economical results are connected, both from an agricultural and manufacturing point of view; on one side enlargement of the usines, on the other increase in the number of rasping houses, which, keeping the pulp on the spot, facilitate the feeding of cattle on the farms.

Last year the sugar factory of M. M. Lefranc, of Havy-le-Martel, was reorganized so as to be able to work the juice from 60,000 tons of beets in a season. Fourteen miles of tubes conducted the juice from the rasping houses without the least difficulty, and in all weathers without interruption.

The usine d'Origny, Sainte Benoite in l'Aisne, was also founded last year. It was constructed to work up 120,000 tons of beet in a season, with pipes 19 miles in length for conducting the juice from the rasping houses.

This year a large central factory has been installed, under the superintendence of M. Linard, at Meaux, on the same system to treat every season, juice from 150,000 tons of beets.

A sugar factory still larger is in course of erection near Abbeville, constructed for the working of 200,000 tons of beets in the season.

The outlay required to establish one of these large factories is less by 33 per cent. than for one on the old system of equal manufacturing power.

It might be thought that the passage of the saccharine juice through the pipes at the slow rate of 20 yards per minute would injure the juice for working. M. Linard anticipated this serious difficulty by availing himself of the antiseptic, hydrate of lime, and he has proved by experiments on a large scale that when the juice has been limed to the extent of 1 per cent. in the first tanks, which serve both for receiving vessels and measures, it will reach the most distant factories without alteration; indeed the passage through the tubes renders the defecation more complete, and the juice is more easily purified by the double or triple carbonatation afterwards.

The inventor by persevering investigation decides on the most favourable position for placing the rasping houses, and the most suitable diameter for the conveyance tubes, which varies between 2½ and 4 inches according to the quantity of juice to be passed through them. He also settles the best course for the tubes to traverse. The strength of the joints has been carefully tested, and their soundness proved by comparing the quantity of liquor sent with the quantity received, and he has found that it is possible by the aid of special contrivances to avoid both breakage in the joints and deposit in the tubes.

M. Linard has also found means of utilising the tubes during the period intervening between the close of the manufacturing season and the new crop. One of the rasping houses of *Origny* being situated on an elevated plain where water is scarce, he has built near the rasping house a cistern to contain 1¾ millions of gallons, which is supplied by means of one of the factory pumps with the water required by the rasping house, and moreover by this means water can be furnished in spring time to the farmers round, who formerly have had at times to fetch it a distance of five miles.

By placing the cast-iron tubes on the low sides of the roads at a depth of 2½ feet the danger of frost is avoided. The authorities

who have control of the bridges, embankments, roads, &c. have benevolently encouraged a scheme which prevents considerable wearing of the roads by the beet waggons.

This system should the more attract the notice of the Imperial and Central Society of Agriculture, inasmuch as it offers a remarkable solution of the interesting problem propounded in the programme of the society in 1836.

It was then proposed to introduce the manufacture of sugar *on the farm*, in order to secure to the farmer a means of preserving large quantities of fruit often wasted in the fields, and at the same time adding to the supply of fodder generally too limited, the the pulp which is so valuable in the feeding and fattening of cattle, thus to increase the production of food.

This double aim is attained by the erection of large central factories which are able to deliver sugar on the best terms, and which receiving the juice prepared around them from a more or less extended circle, yet leave the pulp residues at the rasping houses in the country near to the cattle sheds and sheep folds where the animals are fattened.

In fine the installation of large factories near canals, rivers, and lines of railway, where fuel, limestone, animal charcoal, machinery, &c., are easily attainable and less costly in carriage, realising a saving of 50 or 60 per cent. by substituting the conveyance of limed juice in tubes for the carting of beets in heavy waggons, thus saving considerable expense in repairs of roads, will permit the farmer to share in the profits of the manufacture in a larger measure, by securing to him more remunerative prices for his beet roots.

The persevering development and the successful application of this remarkable system are really services rendered to a great agricultural and manufacturing industry, that of beet sugar production. The section of physico-chemical agricultural science has the honour to propose to you to send to M. Linard acknowledgements of his interesting communications, and to forward this report to the Commission of Rewards.

ON SOME OF THE REACTIONS WHICH ACCOMPANY THE PROCESSES OF PURIFICATION BY LIME AND CARBONIC ACID.

By M. Eug. Feltz.

The attention of sugar manufacturers has lately been directed by many publications to the methods of purification by lime and carbonic acid. The purifying effects produced by these processes are generally attributed by those who describe them to the special properties which the carbonate of lime is supposed to possess when in its naissant state.

At a late *séance* of the Academy of Sciences M. H. St. Clair Deville presented a very important *memoire* on the occult causes, to which we are tempted to appeal every time we do not comprehend any reaction.

He shows the justice of his propositions by many examples, one of which will suffice to show his opinion.

"A body," says he, "when it is formed by a combination is either formed, or it is not formed, it cannot be at one time combined and uncombined, simple and compound. It cannot be *forming*. We imagine a naissant state, to lend to the body a system of properties arbitrarily chosen, in order to explain some facts which are not very clear."

If it is irrational to attribute to hydrogen at the moment when it enters into some of its combinations any peculiar properties, it is altogether incomprehensible that we should have thought of similarly endowing a compound such as carbonate of lime.

Thus, rather than accept the inadmissable explanation given by the inventors and advocates of the new processes, many chemists have preferred with M. Dubrunfaut to deny the alleged purification. The practice of some of these processes leads to conclusions opposed to those of these chemists, and the examination of the juice submitted to the treatment by lime and carbonic acid proves that a real purification has been accomplished. This is not a gratuitous assertion as M. Dubrunfaut seems to believe, but a well

demonstrated fact. If the assay by means of subacetate of lead has not the character of rigorous analysis, it at least proves that a considerable purification is effected by the carbonatation of limed juice properly conducted.

This purification is nothing very extraordinary and there is no need to appeal to the mysterious affinities of bodies in a *naissant state* to account for it.

In a former number of the *Journal des Fabricants* I have endeavoured to explain some of these reactions and I have shown that in the various processes of defecation based on the use of lime alone, or with carbonic acid the fundamental reactions are identical. My experiments on the *defecation trouble* have plainly proved this curious fact, that the carbonatation of limed juice is always accompanied by the elimination of an excess of basic lime, equally apparent in the carbonatation of limed syrups. This elimination of basic lime appears to play an important part in the purification of the juice, and experiments have shown that in carbonating juice containing sediment a notable part of the impurities are redissolved. Divers considerations made in practising on a large scale the various methods of purification have led me to recognize the principal cause of the precipitations, in differences of solubility.

Some compounds insoluble in water or in sugar solution, become soluble in the presence of sucrate of lime. To show more clearly the close analogy which exists between the processes of purifying syrup and those applied to juice, I propose to describe a number of experiments by M. Woestyn and myself with his method of clarification and decoloration.

The colour of syrups is generally owing to the sugar being turned into caramel during the boiling and evaporation. We may then by employing artificial solutions of sugar and caramel produce syrups analagous to those produced in actual manufacture.

In the first series of experiments we endeavoured to ascertain the amount of decoloration effected by the use of lime alone.

EXPERIMENT I.

To 200 c.c. of a solution of caramel in water, containing 0·192 grammes of caramel, 2 grammes of slaked lime were added in a

state of fine powder, The liquid was stirred and filtered. The filtered liquid compared with the primitive fluid by a Duboscq colorimeter showed a tint 7½ times lighter: 87 per cent. of caramel had been eliminated by the lime.

Experiment II.

To 200 c.c. of a solution of sugar and caramel, containing 20 grammes of sugar and 0·192 grammes of caramel, 2 grammes of slaked lime were added. The liquid was stirred some time, then filtered. The filtered liquid compared with the primitive solution far from being decolorized had acquired a slightly darker tint. On being heated to the boiling point no decoloration was effected.

Experiment III.

The 200 c.c. of the solution of sugar and caramel were heated to 158 Faht. Two grammes of lime were added and the solution was then raised to the boiling point. It was filtered whilst hot and it was then found that 45 per cent. of colour had been eliminated. On mixing the precipitate with the filtered liquid it was found on cooling that the colour was redissolved. On mixing the coloured precipitate obtained in the first experiment with lime water it was found that the caramel was redissolved.

The three preceding experiments appear to show that the caramel produced with the lime a deposit nearly insoluble in water but very soluble in limed sugar solution. In experiment III a part only of the lime was dissolved, but the quantity of sucrate of lime formed was large enough to retain in solution more than half the caramel. We may be sure that the decolorizing effect of lime in these conditions diminishes in proportion as the quantity of lime is increased. Thus in three experiments made with 100 c.c. of the same solution of sugar and caramel, to which were added respectively 2, 4, and 6 grammes of lime the decolorations were in proportion to each other as the three numbers 34, 17, and 0. The increased quantity of lime dissolved became sufficiently large to hold in solution the caramel which should have been precipitated. By augmenting the proportion of lime for this defecation we really produce a contrary effect.

Experiments made with the addition of gas, CO_2—

EXPERIMENT IV.

100 c. c. of a solution of sugar and caramel, containing 20 grammes of sugar and 0·166 of caramel, was heated to 158° Faht. and two grammes of lime then added. The liquid filtered hot compared to the primitive solution showed a decoloration of 34 per cent.

Neutralized by carbonation and re-filtered, the liquid compared with the primitive solution showed a decoloration of 58 per cent., thus the neutralization by carbonic acid had produced an additional decoloration of 24 per cent.

EXPERIMENT 5.

To 100 c.c. of a solution of sugar and caramel as before 2 grammes of lime were added when cold. No decoloration was produced; on carbonating the liquid so as completely to neutralize it it showed on filtration a decoloration of 80 per cent.

The carbonation being continued so as to neutralize the lime a little more completely, has changed the nature of the dissolvent, and the combination of lime and caramel soluble in sucrate of lime but insoluble in the sugar solution is precipitated. On putting the precipitate from this experiment to digest with a solution of sucrate of lime, a dissolution of the colouring matter was the result.

The carbonation of the limed sugar liquids produced an elimination of basic lime; this lime may be re-dissolved in the juice and give birth to some sucrate of lime which in its turn re-dissolves a part of the organic matters found in the lime. This is a fact daily shown in the actual manufacture, the juice from the filter presses always containing more lime and impurities than the clear juice decanted on the first saturation. It is then rational that the lime should be added to the juice cold, as it is dissolved without uselessly increasing the quantity of sediment, and that the temperature should be raised before carbonation. This mode of operating is especially important in the purification of beet juice. We know in fact that it is impossible to completely neutralize the limed juice if you do not wish to dissolve the greater part of the impurities precipitated.

If in place of carbonating the beet juice this method of operation is applied to the syrups of the refinery, the saturation in presence of sediment may be carried further. In these conditions but little purification and clarification are effected, whilst the *carbonatation trouble* eliminates from the juice besides colouring matters a notable quantity of other impurities. The combination of caramel and lime appears to be more stable, it will not however resist a prolonged carbonation. The considerable loss of sugar which may result from insufficient carbonatation necessitates the nearly complete neutralization of the syrups by the gas, and the large quantities of lime prescribed by the first inventors render their processes so dangerous in inexperienced hands that it is not safe to recommend their adoption. Thus their patents have remained a dead letter until other inventors have given a more practical solution to the problem.

When a solution of sugar, lime, and caramel is carbonated too long, nearly all the colouring matter becomes redissolved.

50 c.c. of a solution of sugar and caramel treated with 1 gramme of dry hydrated lime, carbonated and filtered through paper had lost $\frac{2}{3}$ of its colour.

50 c.c. of the same solution treated with 1 gramme of lime carbonated a very long time and filtered, did not show any appreciable decoloration. In this second experiment a part of the carbonate of lime, nearly a tenth, was transformed into bicarbonate and was dissolved.

We may also see by comparing these experiments that the elevation of the temperature during the carbonating is useful when we are operating on sugar solutions quite free from glucose impurities. The transformation of uncrystallizable sugar in the presence of lime at a high temperature paralyzes in part the effects or the carbonatation, and we must allow that it is not always useful to destroy it. If the presence of glucose indicates that there has been fermentation in the sugars, it would not be just to attribute the cause to the carbonatation process. We must not forget that there exist glucose factories which proceed as we do filtering through animal charcoal and boiling down their products for de-

livery in the form of syrup as colourless as our refined liquors. If the destruction of the glucose ensured its entire removal from the molasses such a course might be desirable, but the salts resulting are soluble at least for the greater part. It is undoubtedly the presence of uncrystallizable sugar which renders the application of these processes so difficult in cane sugar refineries.*

The decoloration produced by carbonatation on limed beet juice is very considerable, but if this degree of decoloration obtained is taken to fix the proper proportions of lime needful in the process we shall be liable to many mistakes. We may conclude from the experiments given above that caramelised solutions of sugar are not decolorized so easily.

Two solutions being prepared containing the same quantities of sugar and of lime but coloured the one with caramel and the other with a black extract obtained from soaking in water pieces of black dry beet root, these two solutions were examined by the Duboscq colorimeter and found identical. The caramel solution was carbonated and the extent of decoloration found to be 37 per cent. The solution coloured with black beet root was decolorized by the carbonation to the extent of 75 per cent.

The difference in the nature of the colouring matter is accountable for this difference in result. Moreover, even with solutions of pure sugar and caramel the decolorization is greatest when the solution used is of the same density as the juice, in proportion as the quantity of sugar dissolved is increased the decoloration effected by a given weight of lime becomes less. The three following experiments have been made with solutions containing the same quantity of caramel per 100 c. c. but varying in the proportions of sugar.

* Thus Messrs. Williamson, Griffiths & Co., who carry on one of the most extensive refineries in New York, have experienced difficulties in the application of the Wœstyn process which I can only account for in this way. An important Russian refinery has used this process with success for its low products for more than a year, and the factory of Arlovetz which now treats 10 tons of third molasses per day by the Osmose process has found great benefit in applying the Wœstyn clarification to these molasses when osmosed.

1°. To 100 c. c. of solution containing 10 grammes of sugar and ·192 of caramel was added one gramme of dry hydrated lime the mixture was stirred and carbonated, the decoloration effected equalled 37·5 per cent.

2°. The experiment was repeated with a solution containing ·192 of caramel and 20 grammes of sugar; the carbonated liquid showed a decoloration equivalent to 16·6 per cent: 3°. 100 c.c. of a solution containing 40 grammes of sugar and ·192 of caramel treated in the same manner showed a decoloration of 4·8 per cent.

4°. To 100 c.c. of the 40 gramme sugar solution were added 4 grammes of lime, proceeding as before; in this case a decoloration was shown of 44·5 per cent.

5°. 100 c.c. of the same solution were diluted with water to the volume of 300 c.c. and carbonated after the addition of 4 grammes of lime; the decoloration effected was 42·9 per cent.

Although the densities of the liquid were very different in 4° and 5° the decoloration was almost the same. It is therefore rather the total quantity of sugar which is concerned in the reaction than the density of the solution.

We may conclude from experiments 1°, 2° and 3° that the greater the proportion of sugar to a given quantity of caramel the more lime is there required to decolorize. We know that the more concentrated a solution of sugar may be the more lime will it absorb, and the quantities of lime dissolved by juices defecated at a given temperature are so much the greater as the juice is rich in sugar. Thus two sugar solutions containing the one 10 and the other 40 grammes of sugar per 100 c.c. heated with 2 grammes of lime per 100 c.c. added to each, filtered while hot, absorbed, the first ·31 gr. of lime and the second 1·75.

From what has been said above, it will be seen that the phenomena which intervene in the process of carbonation of limed juices and syrups are of a very complex description and that it is difficult to account for them on the hypothesis of carbonate of lime in its *naissant state*. Thus we cannot comprehend how the same quantity of carbonate of lime formed in two liquids containing identical proportions of lime and caramel should produce dissimilar results.

"MIXED METHOD" OF EXTRACTING BEET JUICE.

From the Sucrerie Indigene.

Of all the processes pertaining to the production of [beet] sugar the extraction of the juice from the pulp is without doubt the one which is most open to improvement in the actual manufacture. The presses comprise a large proportion of the plant, very costly to maintain in good working order; they require a staff of robust, trained workmen very difficult to recruit. Whoever then discovers a definite mode of working which will suppress this system and thus render the industry independent of this class of workmen will do it important service. Unfortunately the problem is far from simple, as is proved by the number of projects highly spoken of before they are tried which fail in actual practice.

This question occupies the manufacturers of Germany quite as much if not more than those of France, because, if beyond the Rhine labour is less costly and the plant more economically constructed, on the other hand the duty is not levied on the manufactured article but on the raw material, and one necessary condition of the manufacture in Germany is, as complete an extraction as possible from the root, the value of which is doubled on its entering the factory.

In Germany then as in France there is continual discussion of the relative advantages and defects of hydraulic and continuous presses, of the various methods of maceration and of the diffusion process. The *Journal des Fabricants de Sucre du Zollverein* for February contains an important article on this subject by M. Walkhoff, to which we call the attention of our readers, because it indicates a mode of treatment for the extraction of the juice which appears to us most rational.

In this method, now much practised in Germany and Russia and which was invented by M. Walkhoff himself, the pulp rasped in the ordinary manner without the addition of water falls into a continuous press, by which a part of the juice is extracted. The residue is mixed with a proportion of water representing 25 to 30

per cent. of the original weight of beets, and after some minutes is passed a second time through the press. The residue from this second pressure consists only of pulp almost entirely deprived of sugar. Instead of this second pressure the pulp may be submitted to maceration or to a methodical washing; in this case as the pulp only represents at most a third of the weight of the rasped beet root, the apparatus for maceration need only be relatively small.

From the accounts given in the above mentioned journal nearly 600,000 tons of beet roots are annually treated according to this mixed system. The roller presses employed by M. Walkhoff give from 73 to 76 per cent. of juice before any water is added, the pulp remaining half a minute under pressure. Each press is capable of working 30 tons of beets per day, and one man is able to overlook two presses.

The second passage of the pulp (with the 27 or 30 per cent. of water) through the roller presses brings the *total* return 87 to 88 per cent. of juice of the normal density.

When it is preferred to treat the pulp from the first pressure by maceration, 91 to 92 per cent. of juice of the normal density is obtained, and the entire operation of pressure and maceration only lasts 20 minutes.

Comparing these returns with those obtained by the diffusion process we find according to M. Walkhoff the following results:

	Diffusion.	Mixed method.
Time required for extraction	210 min.	20 min.
Workmen required for each 100 tons of beets	18	10
Yield of juice............	87 to 90 per cent.	90 to 92 per cent.
Added water which passes to defecation	30 to 50 per cent.	15 to 20 per cent.

The results of analagous comparison would be still more conclusive when put beside the working of the ordinary hydraulic presses such as are generally used in France, the return from which rarely exceeds 80 to 82 per cent. of juice of the normal density.

However this may be, we shall be glad if the figures given above determine some of our large manufacturers to try this mode of treatment, which is not we believe the object of any patent in France, and which permits the use of any roller presses, the return from which amounts to 65 to 70 per cent. of juice.

Could not the "mixed method" be applied to the extraction of *cane* juice without much difficulty or expense? One diffusion vessel would be sufficient to receive the megass from the rollers if so contrived that the megass could be easily removed after submersion in the water a short time, so that a fresh lot of megass could be put into the same water, and so on until a sufficient degree of density was reached. All the sugar obtained by this means would be in addition to the ordinary yield, and as few mills extract more than 75 to 80 per cent. of the juice contained in the cane this method might be worth trial.—*Ed. S. C.*

THE DIFFUSION PROCESS.

This process is now employed for the extraction of the juice from the beet-root or from the cane in different countries as under:—

Austria	41	establishments.
Zollverein	23	,,
Russia and Poland	12	,,
Holland	2	,,
Luxembourg............	2	,,
Sweden	1	,,
Madras	1	,,

And, in addition, is about to be applied for the next season in

Austria	11	establishments.
Zollverein	13	,,
Sweden	2	,,
Russia and Poland	3	,,
British W. Indies........	1	,,
Brazil..................	1	,,

ON THE ABSORPTIVE POWER OF SOIL.

BY ROBERT WARINGTON, F.C.S.

(From the Chemical News.)

THE chemistry of soil is a branch of science at present but imperfectly investigated and confessedly full of difficulties. In its full meaning, it implies an acquaintance with all the various forms of matter contained in soil, and also a perfect knowledge of their behaviour under the various conditions to which soil is liable. The chemist has comparatively little difficulty in analysing a soil. He can pull it to pieces, and determine with considerable accuracy the proportion of the various elements which together compose it; but the results thus obtained are only a very partial help in the study of the chemical properties of soil. The analysis fails to tell him in what relation the various elements stood to each other in the original soil, in what forms of combination they actually occurred. The chemist is thus, at starting, only imperfectly acquainted with the compounds present in any particular soil, the chemical properties of which he is about to study. But this is not the only difficulty under which he labours,—he is ignorant to a very considerable extent of the properties and behaviour of those substances which he believes to be present. The constituents which make up the bulk of his soil may be classed under certain heads,—as water, quartz, silicates, hydrated oxides, carbonates, and humus; but how little is known respecting the behaviour of most of these substances under the conditions met with in soil! What is their action towards the various salts, which form so important a part of plant food? What is their action towards the various gases of the atmosphere? What is their behaviour in the presence of decaying vegetable and animal matter? What, again, is their influence on each other when present in different proportions? The subject has been too little studied to allow of any but imperfect answers being given to these questions. It naturally follows, from this immature condition of the science, that while several of the properties of soil

have been very ably investigated, the origin and cause of these properties have been but indistinctly traced; one investigator ascribes a phenomenon to the action of one of the ingredients of soil, while another sees, in the same phenomenon, the sole action of a different soil-ingredient.

In the present paper, we propose to confine our attention to one of the best known properties of soils—their remarkable faculty of withdrawing certain substances from their solution in water.* The subject has received attention only in the last twenty years. It has, perhaps, been more fully investigated than any other part of the chemistry of soil, and richly deserves further study. Did we thoroughly understand it, the whole subject of the conditions of plant food within the soil would be at our command; we might then hope to be able to discriminate between available and non-available plant food, agriculture would gain largely by the increase to our knowledge.

Many an observant farmer must have noticed, long before agricultural chemistry had its birth, that soil has the property of removing very quickly the odour and colour of liquid manure; but the observation, however intelligent, resulted in no permanent addition to our stock of knowledge. Near to our own day, two thoughtful men noticed this fact, and fortunately each of these observers was acquainted with a chemist. Mr. H. S. Thompson, in 1845, made a few careful experiments on the subject, with the assistance of Mr. Spence, a chemist at York, but did not publish his results till five years later. Mr. Huxtable, a short time after drew the attention of Professor Way to the same subject; the result was the publication, in 1850, of Way's now classical paper "On the Power of Soils to Absorb Manure,"† followed by two other papers in 1852 and 1855. Numerous chemists have since made researches on the subject, especially in Germany, and the subject is still being vigorously prosecuted. We propose to give some account of the results arrived at, and the principal opinions

* The absorptive action of soil towards the gases of the atmosphere has been but little investigated, and must be passed over for the present.

† *Journal of the Royal Agricultural Society*, vol. xi., p. 313.

held respecting this property of soils, and also a short description of some experiments recently made at the Royal Agricultural College upon the same question.

Way treated various soils and clays with solutions of ammonia, and with solutions of carbonate, sulphate, and chloride of ammonium. He repeated the same experiments with potash, and with carbonate, sulphate, nitrate, and chloride of potassium. Experiments were also made, though few in number, with salts of sodium, calcium, and magnesium. He found that, when solutions of ammonia, potash, or of their carbonates, were filtered through 10 or more inches of soil, these salts were absorbed to such an extent that their presence could not be detected in the filtered liquid till a very considerable amount of the salt solution had been applied, and the soil had, in fact, become partially saturated. In the case of the carbonates, the carbonic acid, as well as the base of the salt, was generally retained by the soil; but, when the other salts of ammonium and potassium were applied in the same manner, the base only of the salt was absorbed, and the filtered liquid contained the nitric acid, sulphuric acid, and chlorine, united with calcium * derived from the soil or clay experimented upon. The salts of sodium were acted on by soil in the same manner as the salts of ammonium or potassium, but the absorption was less energetic. Solutions of caustic lime, and of bicarbonate of calcium, were deprived of their calcium by passing through soil; magnesium was also absorbed from solutions of its salts. In an experiment with a solution of phosphate of sodium, the phosphoric acid was found to be perfectly retained by the soil. A solution of superphosphate was also completely deprived of its phosphoric acid by filtering through soil. From all these experiments Way came to the conclusion that the affinity exhibited by soils was directed solely towards basic substances. Sulphuric, hydrochloric and nitric acids were apparently not absorbed from their salts; and he was of opinion that the retention of carbonic

* In experimenting with a clay derived from soda-felspar, Way found the filtered liquid to contain sodium salts, in place of the calcium salts usually present.

and phosphoric acids by soil was due only to their forming insoluble compounds with the lime of the soil. The absorption of bases from the solutions of their sulphates, chlorides, nitrates, &c., he considered was brought about through the decomposition of these salts by the lime in the soil; the lime, by combining with the acid, left the base free for absorption.

Way further determined the amount of the absorption in the case of several soils and clays; and, in these experiments, instead of filtering the solution of salt through the soil, a weighed portion of the soil was shaken with a known quantity of the salt solution, and the extent of the absorption determined from the amount of salt showed by analysis to have disappeared from the solution. This method of experiment has been generally adopted by succeeding investigators, though, as we shall see further on, it is not without its disadvantages.

(*To be continued.*)

EXCISE DUTY ON BRITISH SUGAR AND SUGAR USED IN BREWING.

From the Annual Official Report of the Board of Inland Revenue.

British Sugar.

The Acts relating to this duty are the 1 Vict. c. 37, the 3 & 4 Vict c. 57, and the 30 Vict. c. 10.

British made sugar for a long time held a merely nominal place in our list of excisable articles, but during the years 1864-5 two manufactories of glucose or starch sugar were established in London.

The materials from which this sugar is made are chiefly sago and potato starch It has but little resemblance to cane sugar, and less sweetness than the lowest class of colonial sugars.

The duty is charged according to quality, and has been levied chiefly at the rates of 8s. and 9s. 7d.

These two manufactories ceased to work during the next year, and the quantity made has been very small until this year.

Glucose is used principally, if not entirely, in brewing.

Another kind of glucose which has lately come into vogue with brewers is made by a patent process from foreign and colonial sugar on which the Customs' duty is paid, and is sold under the name of "saccharum." It is obtained by the conversion of cane sugar into grape sugar, by means of dilute sulphuric acid.

In the autumn of the year 1868, an application was made to us by Mr. Duncan, a London sugar refiner, who had established a manufactory of beet root sugar at Lavenham, to have a dispensation from the law which requires the process to be carried out in its entirety upon the same premises, in order that the charge of duty, which is ultimately made on the weight of the finished article, should be ascertained by the officers before removal. Mr. Duncan's object was to carry the manufacture at Lavenham as far only as the production of syrup, and to convey the produce in that state to his refinery in London, where it would be mixed with syrup from imported cane-sugar and undergo the usual treatment for obtaining the sugars of commerce. The method of charging the duty on the syrup is adopted in several refineries in Belgium. In France, where it was formerly allowed, we are informed that it is no longer admissible under the revenue laws. We reported to your Lordships at the time, that in our opinion Mr. Duncan's request, should, if possible, be complied with, and that the requisite alterations should be made in the law, but that we could not say, without experiments conducted on a very extensive scale, and occupying a long period of time, whether an estimate of the quantity of sugar producible from the syrup could be made with sufficient accuracy to secure our revenue if the charge of duty were made in that stage of the manufacture. Not being prepared, therefore, for legislation, and at the same time being unwilling to shut up Mr. Duncan's works at Lavenham, we obtained your lordships' authority to allow him to proceed, as proposed, for at least one season; the opportunity being thereby afforded to our officers of ascertaining the best method of charging the duty. In order that we might not incur any suspicion of contravening the arrangements with foreign powers under the convention on the sugar duties, we determined to adopt, for this experimental charge,

the method prescribed by the Belgian government in similar cases, and by the kindness of M. Guillaume, Directeur Général au Ministure des Finances, at Brussels, we were furnished with ample materials for making our practice conform to that of his country.

In Belgium a hectolitre of syrup at a temperature of 15 degrees centigrade is charged as 1,500 grammes of 2nd class sugar for each degree of the densimètre. Now a hectolitre is equivalent to 22 gallons, 1,500 grammes to 3·3069318 lbs., a degree of the densimètre equals 10 of Bates' saccharometer, and 15 degrees of the centigrade corresponds to 59 degrees of Fahrenheit. Hence, a gallon of syrup at 59 degrees Fahrenheit and 1 degree Bates' should be charged with the duty on ·01503 lbs. of 2nd class sugar (which is 10s. 6d. per cwt.), and so on in proportion to the density of the syrup.

We have been thus particular in explaining our mode of charge because we have heard that some of the parties to the convention, misinformed no doubt as to the facts, had remarked upon our having departed from the course prescribed by law in favour of a particular manufacture. It will be seen that even on the small scale, and for the limited period in which we so acted, we, at least, were careful that the duty charged should be precisely that which would be charged in Belgium under similar circumstances.

But as regards our own revenue, and our own importers and refiners of sugar, we were not willing to rely upon the foreign mode of charge without testing it ourselves. This has now been done in our laboratory, and it has been ascertained that the estimate from the syrup is sufficiently near to the result to remove any fears of danger to the revenue from such a mode of charge.

It will be our duty, therefore, to submit to your lordships a proposal for legalising the charge of duty according to the Belgian system.

Sugar Used in Brewing.

The acts relating to this duty are the 10 Vict. c. 5, 17 & 18 Vict. c. 30, 13 & 14 Vict. c. 67, and the 30 Vict. c. 10.

In the year 1847, sugar, which was before inadmissible, was by the act 10 Vict. c. 5, allowed to be used in breweries.

The rate of customs' duty at that time made it unnecessary to impose any further duty as an equivalent for that levied on the malt for which sugar might be substituted. In 1851 the reduction of the customs' duty called for an addition of 1s. 4d. per cwt. on sugar admitted to breweries, and this was increased by the Act 17 & 18 Vict. c. 30 to 6s. 6d. per cwt. So large a rate brought with it the necessity of providing against fraud, and the Act 18 Vict. c. 22 accordingly provided, that those brewers who intend to use sugar should make a special "entry" with our officers, and should take out an annual license at a duty of £1. The act also gave us the power of making such regulations as might be deemed requisite for securing the revenue.

From that time to the present the rate has varied with the changes in the customs' duty. It is now 3s. 6d. per cwt., the amount being determined upon the assumption that 210 lbs. of sugar are equivalent to a quarter of malt (the duty on which is 21s. 8½d.), and that it is the lowest class of sugar, admitted at 8s. by the customs, which will be used.

It is only of late years that brewers have availed themselves much of the privilege given in 1847, and it must be confessed that our regulations for securing the revenue, drawn up, as they were, when it did not appear probable that they would be of any practical importance, fall very far short of effecting their object. In fact we have mainly relied upon the declarations of the brewers themselves.

It scarcely needed a recent discovery, that false declarations have been for many years the rule at a brewery in the country, to prove the defects of our system; but it at least enables us to meet any objections to the more restrictive regulations which we must shortly promulgate by conclusive evidence of their necessity.

A very important question to the sugar refiners, in connexion with this subject, is the practicability of admitting molasses treacle, and syrups for use in breweries; at present they are strictly prohibited.

The closer superintendence of brewers using sugar, which, as before stated, has been forced upon us, goes far to remove some of

our objections to allowing such articles as substitutes for malt, but there still remain some difficulties to be overcome before we could propose to your lordships an amendment of the existing law. But in the meantime we wait to learn whether these syrups could really be used by the brewers. It seems most probable that they would not if liable on admission to the full duty payable on an equivalent of malt, the only duty which we can consistently levy. For we find ourselves precluded, by the convention of 1864, with Belgium, France, and Holland, relating to sugar drawbacks, from allowing any drawback or return of duty on treacle, molasses, or syrup, which must therefore be dealt with as having paid no customs' duty at all, and must be charged with the malt duty. Reckoning 245 lbs. of such materials equal to a quarter of malt, we find the duty per cwt. to be 9s. 11d., and this we understand would make them much less profitable than the low class sugars, from which beer is at present made. Indeed, we have ascertained from some of the principal London brewers that at the present prices of refiners' treacle, which range from 15s. to 19s. per cwt., such a duty as 9s. 11d. would be prohibitory.

DRAWBACK ON SUGAR.

Mr. Crawford asked the Chancellor of the Exchequer what steps he proposes to take with reference to applications made for an allowance of drawback on duty-paid sugar in stock on the close of Tuesday, the 12th day of April last.

The Chancellor of the Exchequer said that the Government had taken into its careful consideration the applications made to them with reference to the drawback on sugar which had paid duty, and was in possession of different persons in this country on the 12th of April last, and they had come to the conclusion that the claim of one class of claimants ought to be admitted, namely, sugar refiners other than those who were originally entitled to a return of the drawback on their sugar. As to the other manufacturers, those who manufacture by centrifugal machines what was called pieces or crystals, it was proposed that the customs' department should

ascertain what amount of sugar was in their possession on the 12th of April last, and had paid duty; and it was intended that they should have a return of that duty, with this qualification, that they should be put as nearly as possible on a level with the sugar refiners of loaf sugar who were allowed to export their sugar, and then to re-import it, and get the drawback. It was computed that the expense of exporting and re-importing the sugar for the purpose of getting the drawback was 3s. per cwt.; and what the Government proposed was to give to those other sugar refiners the drawback on the quantity of sugar they had in their possession on the 12th of April, deducting from the drawback on each cwt. the sum of 3s. It was not proposed to give any other drawback.

Mr. Crawford said that as the answer of the right hon. gentleman would not be satisfactory to the dealers in sugar, he begged to give notice that he should bring the matter at a future stage under the consideration of the house.

CLARIFYING LOAVES BY PRESSURE.

IN the last number of the *Polytechnisches Journal*, Professor Cech publishes a report on the working of a new method of clarifying loaves, invented by M. Kadl, and carried out in the refinery of Rouon in Bohemia. The clarifying is there effected under the influence of pressure, exercised either by an elevated column of clarifying syrups, *clairce*, or by air compressed in a monte jus. The *clairce* in consequence of this pressure passes through the sugar loaves in a much shorter time than in the usual process. When the clarifying operation is completed the loaves remain filled with pure *clairce*, which is removed partly by atmospheric pressure and partly by means of the ordinary succettes. The sugar moulds used in the process of clarifying by pressure are of course of a peculiar construction, in order to admit of the application of hydraulic pressure at the bottom of the loaves. The operation completed, the loaves are transferred to ordinary moulds.

Professor Cech states that all the operations of clarifying loaves by this process are completed in 6h. 53min., the *clairgage* alone being effected in 2h. 36min., and that the loaves are in the best

possible condition. There is no doubt but that it will be possible to clarify three sets of loaves with the same apparatus in 24 hours, when once the workmen are familiarized with the operation.

All the processes of the refinery may be completed in 4½ days, and the loaves then be ready for stoving.

The advantages of the process which are easily seen are—

1.— The good quality of the produce.

2.—Considerable economy of time in the manufacture.

3.—Simplification of the working and oversight, facility for the separation of the syrups which cool in a shorter time.

4.—Rapidity of working the syrups.

5.—Economy of fuel, in consequence of economy of space in the warehouses.

THE CONCRETOR IN GUADALOUPE.

From the Journal des Fabricants.

The following letter addressed to M. Lauriol of Guadaloupe, relates to the operations of the Concretor established at Moulin-à-l'Eau, one of the most beautiful communes of this colony: these operations as reported to us by the writer of this letter have given a most satisfactory result:—

Mon cher Lauriol,

I write to you respecting Moulin-à-l'Eau. Pasquier has been able to surmount all the difficulties of detail which attended the starting of the Concretor. The sugar made by it is magnificent. It comes out of the Concretor and sets immediately. We estimate that it will be worth three francs (about 1s. 3d. per cwt.) above *bonne quatrieme.* We have been to Mineurs this afternoon and have carried three samples to pass through the centrifugal.

One sample of sugar made from sour canes, and not very good, gave notwithstanding a satisfactory result when passed through the centrifugal. The second and third samples were of very good beautiful concrete. The centrifugal dried them in eight or ten minutes, and gave a white sugar valued at nearly 9 francs per 100 kilos, (about 3s. 9d. per cwt.,) above *bonne quatrieme.* We have

not been able to ascertain the quantity of waste for want of scales to weigh it, but as far as we could judge the waste was inconsiderable.

Pasquier put the fire under to-day at 11 o'clock, and up to the time I write 7 p.m., he has made nearly 10 casks of sugar [concrete]. Success is then achieved.

G. DE MOYENCOURT.

MANUFACTURE OF SUGAR.

From the Barbados Globe.

Sir,—Having learnt on Saturday that in many places it has been difficult, or even impossible, to obtain a decent sugar from the cane-juice, owing to its acidity arising from a long spell of dry weather, &c., I feel it a duty I owe to my countrymen to write at once and point out two or three cheap and simple modes of correcting so great an evil.

1.—Last year I wrote to you a letter on the advantage and mode of using alum, and I afterwards had the satisfaction of learning that two of my friends (who subscribe to the *Globe*) acted upon the information of that letter, and obtained a clearer and stronger sugar—*much better* than what they had been manufacturing. *Method.*—Dissolve one pound of alum in one gallon of hot water, and when a skip or strike of sugar is taken off throw half a pint or three gills of the alum water into the skipping cooler and an equal quantity of *clear* lime-water upon it. If the cane-juice has been *over limed*, I would put no lime water or very little into the skipping cooler. In 1845 Mr. C. G. Kidney, at my suggestion and request, used the alum in this way on Lamming's; I got the hint from Dr. Ure's book. Mr. Kidney found so great an improvement in the sugar, that he declared he would never again manufacture sugar without using alum—as long as he could have his own way in the matter. He used about ½lb. of alum to a 38-inch hhd.

2.—Dr. Ure also says, when the cane juice has been *over-limed*, the bad effects of the excess of lime may be easily obviated by a little alum water.

3.—In some cases, the sugar from scorched canes can be made cleaner, clearer, and stronger, by throwing into the racker a good portion of pure well-water, just as a fever patient often derives benefit from drinking plenty of good cold water. The late Mr. William H. Hutchinson, of Coverley, a first-rate planter, a man of clear, sound judgment, told me that when he managed Bayley's he put on one occasion ten per cent. of water into the racker to liquor from scorched canes, and obtained a much clearer and stronger sugar than was made the day before from cane juice of like quality.

4.—The late Mr. N. Cave and Mr. Sainsbury, good planters, had a high opinion of the use of powdered chalk (the whiter the better) instead of lime, or as auxiliary to lime, with liquor that would hardly bear lime, and which would else give a dark, weak, bad sugar.

5.—Weak sugar is made stronger and the grain larger, by putting one skip upon another in the skipping cooler.

6.—Three more things may be done to improve the quality of your sugar. (a) Before tempering let the liquor boil up, or become very hot in the racker, and (b) *take off* the thick black scum that rises, *then* temper cautiously, and (c) let your temper-lime be diluted *much thinner* than what is called milk of lime, and complete the *cracking* in the usual way. You will thus effect an excellent defecation, and ought to obtain an excellent sugar.

Yours respectfully,

J. T. ROGERS.

JAMAICA.

From the West Indian.

By all accounts Jamaica is getting on. Paternal government seems to agree with the island. The speech of Mr. Mackinnon, the unofficial member of the Council, is an important one, and likely to have its influence in this country. This gentleman states that two years ago there was a deficit in the colonial chest of £40,000, but that this has now been transformed into a surplus of £58,000. Is

this a fact or is it not? If it is a fact, hard, substantial, and indisputable, it speaks volumes for the success of Governor Grant's administration. Such a sum applied to the relief of the heavily-burdened community of Jamaica will be sensibly felt. The colony has a large population as a taxable area, but no small proportion of it may be described as non-producing. The weight of taxation of course falls upon the industrious or producing people, who are thus somewhat unfairly handicapped in the severe struggle of life. It seems a positive anomaly that Jamaica should be importing coolies when she has upon the spot all those teeming thousands of acclimatised labourers. The presence of a competing race will, perhaps, stir the dormant energies of the negro, upon whom, to a great extent, the industrial prosperity of the island depends. The experiment will be watched with increasing interest by all the many friends of Jamaica. The suffering which resulted from the carrying out of the grand scheme for the abolition of slavery, established a strong and peculiar tie between the mother-country and the colony, and the recent accounts of reviving prosperity have been received with an earnest sympathy and congratulation.

Emigration to Jamaica.—An "Old Planter" writes to a contemporary as follows:—"Perceiving through the medium of your valuable paper that the Jamaica newspapers are strongly advocating white immigration, I beg to state that having resided there for about 12 years, on different properties, I am fully confident that no white man could undergo the toils of a labourer in that severe climate. About the year 1862 or 1863 Mr. W. H. Cooke, proprietor of Chester Castle estate, parish of Hanover, took out several families for his property, amounting to about 55, including children, half of that number were retained on his estate, the remainder turned over to a Mr. Whittingham, who owned a pen high up in the mountains, and considered to be one of the most healthy parts of the island, yet in less than three years there were not more than twelve remaining alive out of the fifty-five. Again, I ask, what prospects can be held out to white emigrants—perhaps a grant of land of about five acres up in the Virgin mountains, without even

a mule to act; water a mile or two from the apportioned land (except in the rainy seasons), not a shop to purchase the necessaries of life nearer than 12 or 14 miles. If the blacks, who are natives of the island, cannot make a livelihood on a few acres of land, how is it possible that a white man, not accustomed to the climate, can do so? Perhaps, Mr. Editor, you will kindly insert this, so as to warn and put on their guard the poor labourers of England."—*West Indian.*

The new line of steamers from Sydney to San Francisco, touching at New Zealand and Honolulu, has commenced operations. Another line taking the same route is being projected by private enterprise in New York. These increased means of communication are already bearing fruit, by anticipation, in the increasing commerce of the Hawaiian Islands. The custom-house statistics for 1869 show an increase in exports of nearly 500,000 dols.; in imports, of over 100,000 dols.—entirely created by the success of the native whaling fleet during the past season. Upwards of 8,000 tons of sugar were exported. The mercantile fleet of the islands consisted of 60 vessels of all classes, with an aggregate tonnage of 10,000 tons. The quantity of oil exported, foreign and native, was 1,855,879 gallons, and the whalebone, 627,770lbs.

The Darien Isthmus Canal surveying expedition from the United States, it is generally believed, will complete its labours by May 1. Intelligence of its progress has been received to March 16. At that time the commander of the expedition at Caledonia Bay, on the Isthmus, had assured the Indians in that region that they would not be molested, and in this way their friendship had been secured. The surveying parties had penetrated to the mountains, crossed to their western slope, and had had interviews with the Indian chiefs on that side. These surveys were made along the Caledonia River, and are said to have demonstrated that that stream has a rise of only 50ft. to the mountain spurs, while between this point and the plain of the Sucubti River, on the Pacific slope, there is only one and a half mile of surface of higher elevation. This higher elevation, it is believed further surveys will demonstrate, is not over 150ft. On March 16 the surveyors were engaged in running a line to the lowest of the mountain passes, but the work proceeded slowly owing to the dense undergrowth. The expedition is healthy. Doubts are expressed of the friendliness of the Indians on the Pacific coast, but Commander Selfridge, of the expedition, feels sanguine of success. The new Darien Canal treaty has passed a first reading in the Columbian Senate almost unanimously.

BEET SUGAR CULTIVATION IN AUSTRIA.

THE duty on sugar in Austria as in Northern Germany is assessed on the beet roots which enter the factories, and to guarantee the correct valuation, the apparatus in each usine is carefully noted and the yield of sugar valued. From the total of the factories a series of returns is prepared, based on the practice of each, and which must be of great use to all makers of beet sugar machinery.

From these returns Mr. Rad compiles every year an account of the sugar production of Austria, some extracts from which may not be uninteresting to our readers.

In 1867-8 there were in Austria, including Hungary, 151 sugar factories which altogether worked up above one million tons of beet roots or on an average 6,500 tons each. The yield per ton of beet roots was of raw sugar 180 lbs.
of molasses.. 75 ,,
these figures show a yield per cent. in Austria of
8·2 per cent. of sugar and
3·4 per cent. of molasses
a much larger proportion than is obtained in France, which is accounted for by the fact that in the former country the beet is richer in sugar, and that the duty being paid on the root the manufacturer works it closer than it would be profitable to do in France where the duty is paid on the manufactured article.

These 151 factories employ 828 steam boilers of a heating surface of about 44,000 square yards and 837 steam engines of a total force of 6,500 horse power.

For the extraction of the juice 624 hydraulic presses are used and 224 macerators or diffusors. For defecation, &c., coppers, double bottomed, or with serpentines are almost exclusively used. But no reliable statistics are given of the methods of working followed, but it appears that the *double effet* is in more favour than the *triple effet*, 215 of the former machines being in use against 15 of the latter. As regards evaporating apparatus 186 open coppers are in use and 206 vacuum pans. The quantity of fuel consumed appears to be very large, reaching on the average 8 tons of coal for every ton of sugar manufactured, beside wood, turf,

and coke; this may partly be accounted for by the fact that some of the factories are also refineries, and that in some parts the lignite coal is used which possesses only two-thirds of the heating power of ordinary coal. The proportion of animal char used is about 3 per cent. of the weight of beet roots, or about 40 per cent. of the weight of sugar.

Nearly 44,000 hands are employed in the manufacture during the season, of which number two-fifths are women.

Dr. Eisfeld's Process for Revivifying Charcoal.—A recent number of the *Markt Bericht* contains an account of a new process for the revivification of animal charcoal by means of the ammoniacal waters obtained by condensation in the evaporating apparatus of the manufactories. This process, that of Dr. Eisfeld, appears to have given satisfactory results in the sugar factory at Svojsic where it has been employed some years. The operation comprises 1st, the ordinary treatment by acid when necessary; 2nd, the fermentation and washing; 3rd, the boiling with ammoniacal water; 4th, the passing of the charcoal through the revivifying furnace.

According to the accounts given, this mode of working has caused a reduction of 6 per cent. in the quantity of charcoal used in the factory at Svojsic, and the charcoal thus treated is of superior quality especially as regards the absorption of the lime. Below are the comparative analyses of new char, and of char which has been used and revivified by Dr. Eisfeld's process. There is but little diminution in the carbon, but a notable increase in the sulphate and carbonate of lime, though probably less than is customary in char which has been used for purifying beet juice or syrups.

	New Char.	Char Revivified.
Water	6.3 per cent.	3·50
Carbon insoluble matter	11.02 ,,	9.85
Carbonate of Lime	8·10 ,,	11.799
Phosphate of Lime	74·20 ,,	72.85
Sulphate of Lime	0·30 ,,	1·789
	99·92	99·788

THE CROPS IN MAURITIUS AND REUNION.

MAURITIUS.

RAIN is much wanted, and the plantations are suffering in certain parts from the great heat. Partial showers have fallen in some districts, but the rain is not so general as usual at this season, and in the most favoured quarters the canes are short although they look healthy. It is hoped that before the end of this month abundant rains will give vegetation a fresh start, but from present appearances the approaching crop will fall far short of the one which is just finished; some think that the decrease will not be less than 20 to 25 thousand tons.

REUNION.

IT is hoped that the disasters of this colony will in the course of time be overcome, already the happy result appears to be not far distant, since the soil, freed from the epidemic which has so long desolated it, appears to be recovering its former fecundity. But the critical time has not yet passed. A drought almost unprecedented has already seriously affected the canes, both those of the coming crop and those recently planted. In many localities the ground is literally burnt up, and water and forage have to be carried for the cattle. Except at St. Rose and St. Benoit, which have been favoured with some showers, the grain crop is completely lost.

Correspondence.

LONDON, 19TH MAY, 1870.

TO THE EDITOR OF THE SUGAR CANE.

SIR,

In your article on the diffusion process of M. Julius Robert, published in the last number of your very valuable magazine, you have done me the honour to refer to my report upon the results of the diffusion process at the Aska sugar works, and to draw from the data contained in it some general conclusions with regard to the value and applicability of this process. It is with a view to discuss and to modify some of these conclusions that I claim some of the valuable space in your columns, hoping that the general interest which is now bestowed upon this new and very promising process will justify this demand.

In your remarks upon the diffusion process it is taken for granted that the diffusion juice necessarily contains 20 per cent. more water than the mill juice produced from the same cane. This however is not the fact. It is a question of the number of vessels employed in one battery and can be modified according to the requirements of the case.

At the Aska works it was found that the juice, after having passed through six vessels, had arrived at the degree of density named in my report, and it was not considered economical to pass it through two more vessels which were provided for that purpose, for the sake of the saving of 10 or 12 per cent. of water which would have been effected in this manner. The question of effective and economical means of evaporation, with regard to which I fully agree with the opinions expressed in your article, has been carefully attended to at the Aska works, which are provided with the most modern "triple effet" and vacuum pan plant. The evaporation of 10 per cent. of water represents therefore a very small charge only, when calculated upon the ton of sugar produced.

The question of water supply to which you refer is generally much overrated. The degree of purity required for the process is easily attainable. The water from the condenser of a steam engine, for example, is fully as suitable as any kind of ordinary spring or river water or rain water collected in a cistern. My experience hitherto has shown that the fears of planters with regard to scarcity of water have always proved to be without sufficient foundation, when the actual state of the available water supply was carefully ascertained.

With regard to the advantages of the single diffusion vessel experiments are now being made on a large scale by one of the most intelligent and enterprising firms of West Indian planters. The results will probably lead to the introduction of this improved plant in lieu of the battery diffusers which have been hitherto in use and which are still being constructed in large numbers on the continent for beet root extraction. The number of diffusion sugar works now actually at work is 82, and there are 31 additional diffusion plants in course of construction during the present

season. There is one point to which, in conclusion I desire to draw your attention, and which is not sufficiently appreciated by sugar manufacturers in general, viz., the superior purity of the diffusion juice, as compared with ordinary mill juice. The color of raw diffusion juice, before it passes into the clarifier, is that of pale sherry, the quantity of impurities is much smaller, and the raw sugar made from it of a superior quality in consequence. For this reason the diffusion process is the only suitable process for working in conjunction with Mr. Fryer's Concretor, now that the reduction of the sugar duties has made the production of higher qualities of raw sugars imperative. Diffusion concrete will in my opinion prove to be an article which under the new scale of sugar duties will yield good profits both to the planter and to the sugar refiner.

Your very obedient servant,

FERDINAND KOHN,

Consulting Engineer to the Aska Sugar Company, Limited.

TO THE EDITOR OF THE SUGAR CANE.

LONDON, 17TH MAY, 1870.

SIR,

Will you allow me to ask, through the medium of your columns, how the employment of Fowler's steam plough has succeeded in Demerara?

Great things were expected from its successful performance. I must say that I am among those who always regarded it, and who still regard it, hopefully.

The last account I heard was, that a well known and respected firm had despatched a Scotch ploughman to Guiana, to direct, or assist in the experiments.

With all deference to the skill and enterprise of the firm in question, I must say, that if instead of an agriculturist, they had sent the ablest and most ingenious *mechanic* they could find, I should have had much better hopes of a successful issue. The difficulties in the way of the application of the steam plough to the soils of Guiana are not of an *agricultural*, but of a *mechanical* nature. Surely, therefore, the most able and ingenious mechanic

that can be found, and not a good ploughman merely, is the sort of man here required.

If the success of the steam plough be regarded as so important, as I suppose it is, and the horse plough be considered impracticable for Guiana, I would venture to suggest to those who have the power, the advantage of placing upon the colonial estimates a sufficient sum to stimulate and reward the ingenious man who will solve the problem, and show how the steam plough is to be made successful, notwithstanding the small drains.

There exists, as I apprehend, the only difficulty, and as good mechanics are not usually men of capital, perhaps a few hundred pounds besides sufficient colonial wages, could not be better expended than in stimulating and rewarding the mechanic, or inventor, who first succeeds in this important enterprise.

As some apology for troubling you thus far, in respect to the steam plough, I will only add, that the late Mr. John Osborne, a Demerara coffee planter, who was well known to me, took from its outset the liveliest interest in the question of the steam plough. Mr. Osborne was a well informed and highly scientific man, and besides giving a great deal of time to the subject, spent several hundred pounds in experiments, and patented a valuable invention himself. Mr. Osborne was soon afterwards cut off suddenly, in the prime of life, leaving no son, or brother, or partner, to take up his invention; of the merits of which, however, I once heard Mr. John Fowler speak in the highest terms.

I am, Sir,

Your most obedient servant,

A WEST INDIA PLANTER.

FOREIGN PATENTS.

M. M. NEEDHAM and KITE. *Improvements applied to apparatus for the purification of fluids or liquids.*

This patent consists in an arrangement of filter presses which appears to have been suggested by the osmogene. The turbid liquid is conducted into one of two series of compartments each separated from the next compartment forming the second series by a thin metallic partition pierced with

holes and covered on both sides with cloth: on this cloth is placed a sheet of paper on that side of the turbid liquid. It is this sheet of paper which forms the filtering surface. To protect it and prevent its filtering power being destroyed too soon it may be covered with another cloth. These cloths and papers reach beyond the metal sheets and are joined when the screw at the end is closed.

Thus the liquid to be filtered is conducted by a pipe into one series of compartments communicating with each other by passages through the sides of the boxes. The clarified juice forced by pressure through the filtering paper into the other series of compartments communicating with each other by the same means, flows out of the apparatus by a single pipe. The solid matter extracted remains in the first series of compartments, from whence it is taken in the form of cakes when the apparatus has been dried.

M. SCHRIEBER, à Saint Quentin (Aisne). *Improvements in the triple effect apparatus employed in the sugar manufactories for the evaporation of the juice.*

The arrangements which are the object of the patent have two aims: to facilitate the cleaning and repairing of the sets of tubes and to regulate the progress of the steam and of the liquid in the apparatus.

To attain the first aim, M. Schrieber makes the tubes and the steam box in a single piece, which is fastened into the pan by screw bolts, so that it can be removed for cleaning and repair, whilst the work may be carried on by another set of tubes, &c., fixed in its place.

To adjust the action of the steam, M. Schreiber divides the steam chest into three compartments by 2 diaphragms, and the passage of the steam from one compartment to another is so arranged as to prevent it passing to condensation before it has equally licked all the tubes.

There remains the regulation of the concentration of the juice. In the ordinary mode of disposition, in consequence of the enormous disengagement of steam effected in the tubes, a part of the juice is carried to the top and has from the same cause a difficulty of finding its way to the bottom of the pan where density is given to it. To prevent this irregularity, M. Schreiber leaves between the steam chest and the pan a circular space of about 4in. diameter, in the middle of this space he places a copper bell, in the centre of the top of which is a circular opening like the neck of a wide mouthed caraffe. When the juice begins to boil its volume is much greater than afterwards, so that the bell is made to rise or descend according to the height of the liquor in the pan, the opening in its top always remaining below the level of the boiling liquid. The juice towards the surface from all the boiling tubes meets and follows the bell plate and passes through the opening in the middle of it, and descending on the outside of it a current is formed towards the bottom of the pan, whence the juice insufficiently

evaporated passes by the tubes or the space between the bell and the steam chest, and in its ascending course concentration is effected.

M. M. Mariole Freres, Saint Quentin (Aisne). *Apparatus called an "injector-condenser," intended to replace the air pumps employed to cause a vacuum in the coppers or pans for evaporating or crystallizing at a low temperature various kinds of liquids especially saccharine juices.*

The injector-condenser consists of a Gifford injector supplied by water from a reservoir above, and provided with a second covering which communicates with the space in which it is intended to form the vacuum. The jets of steam and water from the injector call forth, carry away and condense the vapours which escape from the boiling liquid. A tap regulates the entrance of the steam from the injector and a screw-wheel which raises the central steam tube of the injector regulates the opening of the passage for the water and consequently the condensation.

To set it to work a jet of steam is introduced into the tube of communication from the injector to the copper. The apparatus will serve for one or more vacuum pans and it may be placed horizontally or vertically.

M. Gronnier, à Pont-sur-Saulx, (Meux). *Application to the carbonatation of sugar solutions of the gas proceeding from the combustion of coal."*

The principal object of this patent is the substitution of coke or coal with lime in the production of carbonic acid gas.

Alternate charges [into the furnace] are made with coal and chalk. The patentee omits the important information as to the relative proportions of each and the sort of coal used. He claims as improvements: 1st. the suppression of furnace grates and the substitution of a simple central grate to keep the mass burning and to facilitate the entrance of the air needful for the combustion of the coal, &c. 2nd. The closing of the furnace mouth and the introduction of the coal and lime by a sliding hopper. 3rd. The addition of a damper to increase the draft in case the burning materials should smoulder.

M. Eisfeld, Prussia. *Process for the revivification of animal charcoal.*

Our attention was called to this patent by the analysis given in our last number from the "Mark Bericht" of Vienna. We wished to know what the patentee meant by the boiling with ammonia water proceeding from the evaporating apparatus. This operation consists in the introduction into closed cylinders of char and ammonia water and then heating or boiling by steam.

The apparatus appears by the plates accompanying the patent and certificate of addition to be both complicated and costly.

La Sucrerie Indigene.

EXPORTS FROM HAVANA AND MATANZAS, FROM JANUARY 1ST TO MAY 5TH, IN THOUSANDS OF PACKAGES.

	1870.		1869.		1868.	
Destination.	Boxes.	Hhds.	Boxes.	Hhds.	Boxes.	Hhds.
United States	176	66	324	52	201	45
Great Britain	263	17	199	6	237	9
North Europe	26		20	..	32	..
France	69		69	..	72	..
Spain.............	117	1	87	2	91	1
South Europe	4		4	..	11	..
Other parts	8		4	..	9	..
	662	84	707	60	654	55

	1870.		1869.		1868.	
Stocks.	Boxes.	Hhds.	Boxes.	Hhds.	Boxes.	Hhds.
Havana	462	12	253	6	350	5
Matanzas	110	22	65	12	96	12
Total	572	34	318	18	446	17

SHIPMENTS OF SUGAR FROM THE MAURITIUS UP TO THE 11TH MARCH FOR THE LAST THREE SEASONS.

	Crop 1869-70	Crop 1868-69	Crop 1867-68
	Tons.	Tons.	Tons.
United Kingdom....	32,750	18,500	40,350
France............	9,600	5,350	1,650
Australia..........	34,350	27,850	24,000
India	28,250	13,000	24,400
Cape Colony	1,150	650	1,350
Other ports	1,000	400	120
	107,100	65,750	91,870

European Beet-Root Sugar Crop for 1869-70, (calculated from the latest returns) compared with the two previous seasons, in thousands of tons.

	1869-70.	1868-9.	1867-8.
Zollverein	208	208	165
France	285	284	225
Austria	108	76	93
Russia	100	65	27
Belgium	45	37	31
Poland and Sweden	32	22	15
Holland	12	10	7
	790	632	634

Stocks of Raw Sugar in the Chief Markets of the World, in thousands of tons, to March 31st.

	1870.	1869.	1868.
United Kingdom	95	90	83
France	111	100	86
Holland	36	41	39
Zollverein	29	40	16
United States	95	40	31
Cuba	99	56	72
Total	465	367	327

Consumption of Sugar in Europe and in the United States, in thousands of tons, for the years ending March 31st.

	1870.	1869.	1868.
Europe	1287	1218	1193
United States (imported sugar)	389	442	390
	1676	1660	1584

SUGAR STATISTICS—GREAT BRITAIN.

TO 21ST MAY, 1870 AND 1869. IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	17	2	..	7	27	19	27	4	2	13	46	47	19	2	3	6	30	61
British East India	12	2	..	..	14	9	4	..	..	..	4	8	6	1	..	..	7	8
Mauritius	6	1	1	2	11	5	9	2	7	4	22	14	6	..	8	2	16	17
Cuba	7	4	3	13	27	14	3	8	11	29	51	29	6	8	7	22	43	34
Porto Rico	2	6	..	1	9	2	2	9	..	1	12	3	2	5	..	1	8	5
Manilla & Java ..	33	8	1	1	43	58	8	7	2	2	19	29	11	6	1	3	21	18
Brazil	..	14	..	5	20	15	..	24	2	10	37	32	..	17	3	7	28	38
Beetroot, &c.	3	1	..	1	6	3	14	6	3	14	36	22	12	6	3	16	38	22
Total, 1870 ..	81	39	6	31	157	124	68	60	27	73	228	184	63	46	26	58	192	202
Total, 1869 ..	79	28	4	13	33 increase		75	35	22	52	44 increase		73	44	22	64	10 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

During the last month the raw sugar market has been in a very abnormal state; fair prices have been paid for the better class of goods, but lower qualities have been exceedingly depressed. There has been no speculative demand, and refiners anticipating enquiry for the better sort of crushed and pieces, have neglected low raws to such an extent that fair Jaggery and unclayed Manilas have been sold at 19s. per cwt. duty paid. As these prices involve a loss to the importers, the large supplies of this class of sugars may be followed by proportionate scarcity before very long. During the last week there has been more firmness displayed and higher prices have been obtained. Refined sugars of all descriptions have been in good demand, and prices firm. Common brown lumps are quoted at 40/6 to 41/- in London.

Anticipations of increased consumption in consequence of the reduced duties, have combined with other causes to bring large supplies of sugar from all parts to this country. The imports for last week show an increase of 15,000 tons, and from the 1st January to the 21st May of 44,000 tons. Deliveries which during the first four months of the year had fallen off considerably have latterly increased, during last week alone nearly 7,000 tons. Stocks at the four ports are in excess of those at the same date last year by 34,000 tons.

Notwithstanding this increase in stock and the large arrivals, there is a probability of a return to a more healthy tone than has lately prevailed. Supplies in second hands are still very small, the trade having continued to buy only for immediate wants. Stocks on the Continent are very slightly, if at all in excess of last year, and consumption is steadily increasing in all parts. The latest intelligence from Cuba, that the Spanish authorities had proclaimed freedom to the slaves of the insurgents, shows that the rebellion is by no means suppressed, and the step is not unlikely to cause new complications in this large source of supply.

THE SUGAR CANE.

REGISTERED FOR TRANSMISSION ABROAD.

No. 12. JULY 1, 1870. Vol. II.

☞ The writers alone are responsible for their statements.

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SOME REMARKS UPON THE CULTIVATION OF THE SUGAR CANE IN THE LEEWARD ISLANDS.

By J. Spencer Hollings.

I propose in the first place to divide this subject into its different parts, and treat each separately.

1st.—The manuring of the land, whether by green dressings, farm-yard, or artificial manures.

2nd.—The preparation of that land so manured.

3rd.—The planting, weeding, and general management of the young canes.

4th.—The cutting of the canes, and preparation for the manufactory, with a brief remark upon the system of ratooning.

Manuring.—On the ground that plants are best manured by their own decayed leaves, or ashes, it is strongly maintained by some that the megass should be returned to the field immediately after leaving the mill; arguing that coal is the better and cheaper fuel for the manufactory. Granting this, we should have at once an abundant supply of manure, though bulky in form, but experience has clearly shown that coal is neither our best nor our cheapest fuel; this forbids our considering megass as available to any extent as a manure, for as the crushed canes are consumed in the boiling down of the juice, it is their ashes alone that remain to be dealt with, and of these the larger portion is carried up the chimneys, and wafted away by the wind, so that a very small proportion of this valuable fertilizer remains; this is usually applied as a top

dressing about two months after the canes have been planted, a pint or more being deposited round each cane stool. It is of the greatest importance to keep the ash dry, and to apply it as soon as possible, as its most valuable constituents are readily soluble.

Of vegetable manures, perhaps the best is the Bengal bean, as in about four months a heavy covering of highly succulent leaves and stalks is produced; the months of June, July, and August are the best for planting this, and as the cane crops are then just reaped, and the land would otherwise be lying idle, it is a most convenient manure as well as a valuable one ; the cane trash, or voura, is simply hauled up in straight rows on the top of the old cane stool, as if for ploughing, and the Bengal bean planted about two feet apart on either or both sides of the voura (I should premise that throughout these remarks the cane bank is considered to be six feet wide). It will be fit to cut in about four months, and if the weather has been favourable for its growth, will carpet the field with vegetable matter to the depth of two feet or more.

The pigeon pea, an equally good plant for the purpose, takes nearly double the time to reach maturity, and to ensure a good dressing, must be planted at a very inconvenient season of the year, viz., from November to February, at which period the land should be under the plough if not already planted in canes; the stems also being of a woody texture, require a longer time to rot after they are bedded in, and thus prevent the horsehoe being used as soon as is desirable for the benefit of the young cane sprouts. It is not therefore as valuable as the Bengal bean, except upon stiff clays, where the mechanical effect upon the soil from the stems rotting fully compensates for these drawbacks. The mode of planting is precisely similar to the Bengal bean. There are several other plants used for green dressings, as the Guinea corn, Indian corn, &c., &c., but none so throughly adapted for the purpose as the two above described.

Bushing is a term applied to another method of manuring, there is much to be said in favour of this plan, for it is the quickest mode possible when a field has to be replanted immediately ; the necessary material too is always to be obtained from the wooded hills which

adorn most of the West Indian Islands. It is usual to send a few men into the ravines, or on to the mountains, to cut the young boughs from the trees, and to collect the leaves, &c. These are tied up into convenient bundles and carted to the field, to be bedded in the manner hereafter described for the Bengal bean; a covering of leaves, six inches in depth, all over the field, is a good "bushing;" the great drawback to the general adoption of this system is expense of carriage.

Of farm-yard manures, and the mode of applying them, I shall say but little. It is usual to keep a large herd of cattle upon an estate, which are penned in the yard, or tethered in the field; in the former case they are fed with the green tops of the cane cut up in an ordinary chaff-cutter, and mixed with the scum of the cane-juice from the clarifiers, and linseed meal, or some other fattening condiment; the bands from the cane heap are also thrown into the pen for the double purpose of being trodden down and absorbing the liquid manure; the whole surface of the pen is occasionally earthed over. In the latter case the cattle are chained to stakes, so as barely to allow freedom of movement, and are fed with the green tops uncut, these are brought by carts in convenient bundles from the cutting field.

ARTIFICIAL MANURES.—Upon no subject perhaps is there greater difference of opinion among planters, some advocating the use of Peruvian guano, some sulphate of ammonia, others soot, &c. A decided preference for the first-named is the result of the writer's experience. The best mode of application is to scatter a measure of about four square inches of guano on the bottom of a small hole of about eight inches cube, which has been dug on the windward side of the cane stool; the hole is immediately filled in again. Its position is thus defined, because in the West Indies the rain almost invariably comes from one quarter, and if the guano were applied to leeward, it would not derive any benefit from the light showers; many successful planters never apply artificial manure to any but ratoon canes, and always in the proportion above-named, which equals one ton to five acres. Nitrate of soda and sulphate of ammonia are distributed in the same manner; the best time for

their application is after a good shower, when the clouds portend more rain. The proper age of the canes—just as they are beginning to bunch and to make joints.

THE PREPARATION OF THE LAND.—The first step, whether the manuring has been by Bengal bean, pigeon-peas, yard or other manure, is to place it in regular rows of six feet apart (sometimes five, and occasionally seven), and to give a light covering of earth to prevent loss from the effects of the sun and air; if a green dressing, too much care cannot be taken to bed it in before the fly has committed any ravages, and immediately it is cut, as every hour lost decreases its value. The plough is then put to work as soon as possible, and forms a bank of earth over the row of manure, by taking two cuts on each side, forming at the same time a furrow midway between the rows; this, if the plough is a good one, and the work properly done, will be from twelve to fifteen inches deep, measuring from the crest of the bank to the bottom of the furrows; if not fully a foot deep, it must be subsequently deepened in the process called "hauling up the banks," which is generally done by a gang of labourers with hoes, who shape up the banks, and sink the furrows where required at the headlands, &c., leaving the field with a fine tilth and the rows perfectly straight. It is now ready to crosshole; for despite the severe censure of many writers upon the subject, this system still holds its ground, and is likely so to do. The crossholes are dug across the furrows about eight or ten inches deeper than it, and to the full width; the mould dug out is heaped up, and the top levelled off between each crosshole; six feet apart is found to be the best upon rich lands; on poor soils or hill sides the distance can be lessened to five, or sometimes four feet with advantage; the line of crossholes should form a right-angle with the bank, and be perfectly straight, as the horse hoe is then able to work in every direction, to weed, mould, or harrow when required. The field is now ready for planting, and presents to the eye somewhat the appearance of a gigantic chess-board, the crossholes representing the black squares, the only difference being that the black squares are only about half the size of the white.

Thirdly.—In no department of his business is so much care required from the planter as in the putting in of his crop: and it

is of the greatest importance that it should be planted in the right season. In the Leeward Islands, where the writer has lived for many years, this is found to be between November and February; December being the best, canes planted in this month invariably turn out well. If planted before November, the rains at that season cause a rapid growth of the young sprout, and the cane begins to form joints in the middle of the dry weather which is fatal to its prosperity. If planted after February, it does not attain its full growth, but ripens prematurely. The cane plant should be cut from the stoutest, and best canes, high up, so that the sap may be of the lowest density possible, and about eight inches long, with not less than three well developed buds or eyes; the plant should have the two lower joints stripped of their leaves, so that the bud may come in immediate contact with the earth, and the lower end should be cut off about half an inch below the last joint-ring. Having got the plants all ready for planting, it will repay the planter to spend another half hour in re-examining the heap, to see that no inferior or barren plants have been thrown in, as he will by this means save much time and annoyance afterwards; one should then be planted in the bottom of each crosshole, putting it in upright and in the centre of the hole, leaving not more than one inch of it to be seen. If no sprout appears within three weeks, it must be supplied by another, or by digging it out and planting two others for security, and so on until the whole field is properly established, during which time it must be carefully weeded with the hoe, taking pains to keep the crossholes free of loose dirt.

As soon as the young sprouts attain sufficient growth to show themselves over the bank, the land must be constantly stirred and broken up by the horse hoe, grubber, subsoil plough, or any other implement that will do the work well and effectively, and the young plants moulded lightly; this may be continued with advantage until the canes begin to send roots into the banks, when weeding with the hoe only must be again resorted to, until the canes are fit to cut. In some islands trashing the canes is thought very highly of; this is done by taking the dried blades off the old canes and strewing them over the banks of the young fields to protect them from the effects of the sun, but in the system adopted in St. Kitts

and some of the neighbouring islands, which is the one under consideration it is never done.

Fourthly.—When the canes are ready to cut, the ripest fields are selected, without regard to date of planting, and manufacturing operations begin generally about the middle of January. It is better to commence early, even though a little loss results from the canes not being perfectly ripe, as the depreciation in over-matured canes is always greater. Having decided which field to cut, the gang is sent with bills or cutlasses, each man taking a row and cutting the canes, first docking off the top, from which he cuts the plant; this he throws on to a heap; he then cuts the cane down as close to the ground as possible, lopping it into two or three lengths of about four feet each. The canes from two cutters are thrown together in regular alternate rows, and the tops in the intermediate space. This gives ample room for the carts to travel over the field between the cane rows without crushing the canes, and also facilitates the tying operations, as it is usual for one person to tie the canes from two cutters. It is of importance that the canes should be completely freed from all shoots, blades, or roots, as they cannot fail to injure the quality of the sugar; and that the interval between cutting and manufacturing should not be longer than two days if possible, but shorter if convenient. As soon as the field is cleared of canes, if it is intended to be ratooned, the trash or voura should be hauled from every alternate row upon its neighbouring bank, thus leaving one row clean and the other with a double share of voura; the old cane stool should be moulded over completely, so that the young shoots may spring from below the ground. The clean bank must then be thoroughly broken up with the subsoil plough, and afterwards grubbed so as to destroy all the old roots, and enable the sprouts to put out fresh ones; the trash may then be removed to the ploughed bank, and the other treated in the same manner. The weeding machine or hoe harrow is then kept briskly working, as in the case of the plant canes. When the ratoons are two or three months old guano may be applied with great advantage. Plant canes treated in the manner I have described generally yield from two-and-a-half to three tons per acre, and ratoons about half that quantity.

ON THE VARIOUS QUALITIES OF SUGAR PRODUCED IN CUBA AND THE DIFFERENT MODES OF MANUFACTURE.

By Edward Beanes, F.C.S., Assoc. Inst. C.E., M.R.I.

The various qualities of Cuban sugar may be classed as follows:—

1.—White clayed.
2.—Grey clayed.
3.—Yellow clayed.
4.—Brown clayed.
5.—Ordinary muscovado.
6.—Muscovado purged in centrifugals.
7.—Sugar made from molasses.

The greater or less superiority in these various classes of sugar depends very much on the kind of apparatus used in their manufacture.

The principal apparatus in use may be classed as follows:

1.—The common battery.
2.—The common battery in conjunction with a vacuum pan.
3.—Steam defecators with animal charcoal filters, vacuum pans, and centrifugals.

I will now describe each apparatus in order, and the mode of treatment, commencing with the cane juice.

The Common Battery.

The common battery is usually composed of a clarifier and four coppers, namely, two coppers holding 600 gallons each, and two holding 225 gallons each. The clarifier is an oblong copper vessel placed on the battery flue, and holding about 650 gallons.

The cane juice as it leaves the mill is passed through a coarsely perforated copper strainer, and is thence conveyed to the clarifier (cold juice tanks having become almost obsolete), and then into the coppers which are commonly termed *tachos*. A portion only of the requisite quantity of milk of lime is added to the juice while in the clarifier, and the rest is added generally to the first copper, though occasionally a part is added to the second. The reason given by

sugar makers for the use of lime is that it neutralizes the acidity and causes the scum to coagulate on heating the juice. They judge of the quantity of lime required by smelling the vapours rising from the coppers. If the quantity used is insufficient, the steam has the vapid smell of the scum; if too much has been employed it has on ammoniacal odour, more or less pungent according to the amount of excess—the proper quantity of lime gives a scarcely perceptible smell of ammonia. After the lime is added and the heat of the fire is increased the scum rises to the surface and is skimmed off: the juice is not allowed to boil till after the thickest portion of the scum has been removed. It is then brought to the boiling point and the concentration and skimming continued, till the syrup arrives at sugar point (about 42° Baumè). During the concentration the juice is baled from the larger to the smaller coppers, point being given in the last which is placed over the furnace. Whether the product is intended for clayed or muscovado sugar so far the process is the same, but a stronger point is given to clayed than to muscovado sugar.

Assuming that clayed sugar is to be made, the dense syrup is baled out of the last copper into an oblong wooden vessel called a *cooler,* and after a few minutes repose is beaten up by means of a revolving cage with the view of cooling it quickly, and thereby preventing the formation of large crystals, or as they are technically called grains. The beating is considered sufficient when, by the formation of small crystals, the sugar feels gritty to the touch, it is then baled from the cooler into conical moulds, the apexes of which are roughly closed by means of wooden plugs. In from 12 to 18 hours, according as the sugar is of a strong or soft grain it is sufficiently set to allow of the removal of the plugs. Molasses then commence to drain off, and on the second day the drainage is assisted by the process of *claying.*

After scraping the surface of the sugar, although this process is sometimes improperly omitted, a layer of stiff clay or rather stiff mud of about two inches in thickness is placed on the base of the inverted cone of sugar; this is left on generally about four days if the sugar is of a strong grain otherwise it is removed sooner.

The sugar is now partially allowed to dry for a day and then another layer of more liquid clay of from half an inch to an inch in thickness is placed upon it; this is allowed to remain till it has lost all its humidity: it is then removed and the sugar left to drain and dry: the whole operation of claying occupies about twenty-one days.

The sugar being now sufficiently dry to allow of its removal from the purging house, it is knocked out of the moulds and placed on large shallow trays called *dryers;* these are placed on small wheels and run each on its own tramway and are so arranged that they can be placed in the open air in fine weather or immediately run under shelter on the approach of rain.

When the cone of sugar is removed from the mould it is seen that from the base towards the apex for about two inches it is white, then as the apex is approached it is yellow or grey, and lastly brown. The difference in color is owing to the more or less quantity of molasses held between the crystals of sugar, with the exception of the grey; this color is owing to *insoluble matter shut up between the plates* of the sugar crystal.

The cone of sugar is cut transversely and separated into the classes before mentioned, each kind being placed on separate dryers, crushed and then dried in the sun, with the exception of the brown which is usually stove dried. The several qualities of sugar are afterwards packed in boxes and sent to the market. Some planters divide the cone into *five* different qualities, namely, white, second white, first and second yellows, and lastly brown.

(To be continued.)

THE SUCRATE OF HYDROCARBONATE OF LIME APPLIED TO THE DEFECATION OF CANE JUICE.

By MM. Boivin Loiseau & Cie.

From the Journal des Fabricants de Sucre.

We wish to bring before the attention of the sugar industry some new methods of operation which present considerable advantages over the processes employed at present.

In the manufacture of sugar from the cane it is only in the machinery that any important improvements have been carried out, notwithstanding the many attempts that have been made to introduce some methods of purification of which cane juice is always in need.

In the manufacture of sugar from beet root on the contrary, the first and the most important improvements are owing to the processes of purifying the saccharine juice; it is to these processes chiefly that this industry owes its great prosperity. It is certain in fact that the manufacture of sugar from beet roots would never have acquired such rapid development, and have attained such an important reduction in the cost of manufacture (although it has been greatly favoured by the necessities of agriculture), if, as is the case with Colonial sugar, it had continued to adhere to its primitive methods of purification.

It has been frequently attempted to submit cane juice to the same methods of purification which have been applied to the juice of the beet; but all these attempts have had the end that might have been expected; in fact they have proved complete failures.

It is much to be regretted that a firm like Messieurs. Périer, Possoz, J. F. Cail, & Cie who have made great improvements in processes of defecation applicable to beet juice, should have so completely ignored the chemical reactions which they have produced by their methods as to attempt on the juice of the cane an application which can only totally miscarry.

It is the more to be regretted because their fruitless attempts have assisted in spreading the mischievous error that the use of

lime with carbonic acid can have no place in the purification of cane juice.

The juice of the cane may, however, be the subject of some important ameliorations, if it is treated in a rational manner by lime and carbonic acid, and proper allowance made for its character and the nature of the impurities which it contains.

Such is the result which we have obtained by using a substance of which our firm have made known the composition and the remarkable properties.

This body to which its inventors have given the name of *Sucrate of Hydrocarbonate of Lime* is composed of sugar, lime, and carbonate of lime.

To apply the sucrate of hydrocarbonate of lime to the purification of saccharine juices a series of operations is required which we will now briefly describe.

Production of the Lime and Carbonic Acid.—Lime and carbonic acid are needful for the formation of the sucrate of hydrocarbonate of lime. These two bodies are obtained simultaneously by burning in a kiln the various calcareous substances found in nature. A pump draws from the furnace the gaseous products rich in carbonic acid which are led through an apparatus where the gas is washed and cooled, it is then stored so that the carbonic acid can be utilised.

The calcareous substances which have lost their carbonic acid form the lime which is prepared for use as wanted by being hydrated. The lime which it is convenient to use for each operation is either weighed or measured and it is then slaked with the least proportion of water possible in a metal cistern.

Preparation of the Sugar and Lime Solution.—A certain quantity of juice which is to be purified is then allowed to flow on to the hydrated lime, and is intimately mixed with it so that the lime is completely dissolved by the sugar. The contents of the cistern are then emptied by a pipe which conducts the solution into a sieve placed above a reservoir from which it is drawn up into the large regulating cistern.

Formation of Sucrate of Hydrocarbonate of Lime.—The sucrate of hydrocarbonate of lime is formed of the solution above

described with the addition of the carbonic acid gas. To effect this the solution is allowed to flow into smaller cisterns, and carbonic acid gas forced into it from the gasometer through a rose with orifices 5 to 8 millimetres in diameter. At first the mixture is very frothy but it gradually becomes less so, at which time it will be found to be sufficiently carbonated, having become gelatinous and incapable of decantation, and if analysed by some simple process would be found to contain sugar, carbonate of lime, and lime not carbonated; it is this compound which is called sucrate of hydrocarbonate of lime.

The Utilisation of the Sucrate of Hydrocarbonate of Lime.—To utilise this compound it is simply needful to boil for a few minutes the saccharine solution in which the flaky gelatinous compound has been formed. In order that the reaction may be as complete as possible this operation is performed in a closed vessel from which the vapour can only escape by a valve at a pressure corresponding to a certain temperature; when this has been reached the steam by which the vessel is heated is turned off and the contents are emptied into the first series of *filtres à plateaux* in which the deposit remains.

Saturation of the Filtered Juice.—The juice thus treated will be found still to contain a little lime which it is needful to separate from it; it is therefore saturated with carbonic acid gas so that the whole of the lime contained in it becomes carbonated; this juice is again boiled to drive off the excess of gas and to precipitate the carbonated lime. After this the juice is passed through a second series of *filtres à plateaux* which removes all the deposit. The filtered juice is now ready for the usual operations of manufacture, the charcoal filters, the *triple effet, &c.*

The deposits from the two series of *filtres à plateaux* may then be washed and the water used for washing the char instead of pure water.

Principal Advantages of the Sucrate of Hydrocarbonate of Lime Process.—In the application of our process nothing is uncertain; all is carried out according to rule. Although essentially chemical our methods are conducted with perfect regularity without any necessity for recourse to be had to chemical analysis.

The reaction of the sucrate of hydrocarbonate of lime in the midst of the cane juice allows of the elimination of a large quantity of matter which is adverse to the crystallization of the sugar; it does not impart to the juice those discolorations which (more or less) accompany the common use of lime when employed to neutralise the acidity of the juice immediately on its issuing from the mill, and to give it the alkalinity needful for the proper preservation of all the saccharine matter.

Now, the first good effects which result from the employment of sucrate of hydrocarbonate of lime is the attainment of the results just named, the annihilation of all the fermentive principles and the destruction of the uncrystallizible sugar, the coloured derivatives of which are combined with the base of the sucrate and form the insoluble compounds which remain in the deposit.

Thanks to the use of sucrate of hydrocarbonate of lime *all* the saccharine products will be alkaline because from the weakest juice to the syrups of the last *jet* there will be nothing to arrest the course of manufacture.

No more modifications of the sugar during the whole of its extraction, this is evidently one of the first steps in advance for the maker to take in his manufacture; for he knows how quickly fermentation supervenes in the present method of working, he knows what a short time is sufficient to render uncrystallizable a large proportion of the sugar contained in the juice.

The syrups obtained from the juice purified with sucrate of hydrocarbonate of lime are nearly colourless and very limpid, and are easily boiled without becoming coloured, and as they are deprived of all the germs of fermentation their working is not attended with those losses which the sugar planter knows too well; they crystallize freely, and the sugars obtained from them are white and pure; consequently they will keep as well as beet root sugars obtained by the most perfect processes.

In short, in working these syrups to the second and third *jets*, instead of obtaining a dead fine grained sugar that the refiner will scarcely look at, a large bright grained sugar is produced which is always in request.

The sugars being very pure are not liable to modification during course of transport, and sold by analysis will command a good price on account of their freedom from glucose and other impurities, and consequently their very high percentage of pure saccharine, superior to what is generally attained in usines where the most expensive machinery is employed.

More considerable return, sugars very white, very pure, and easily preserved, and the obtaining of these results with the greatest facility; should not these be the aim of every sugar manufacturer? And precisely these results may be attained by our method.

Before our invention the calco-carbonic method was not applicable to *all* kinds of sugar in the refinery, it was not merely on the juice of the cane that the *carbonatation double* and *trouble* had failed.

Now that the use of the sucrate of hydrocarbonate of lime renders the alkaline mode of working practicable in refineries, there is nothing to prevent the same compound being applied to the purification of the juice, and thus render alkaline the working of all the products of the cane.

The use of sucrate of hydrocarbonate of lime which gives such excellent results in the refinery, and which we propose for the use of the cane sugar manufacturer will be adopted next season in many manufactories.

Paris, 7th June, 1870.

Messieurs Périer, L. Possoz, J. F. Cail, & Cie have replied to the above in the columns of the journal in which it appeared, asserting that M.M. Boivin and Loiseau's method is nothing more than an application of one of *their* patents, and that these latter gentlemen can lay claim to nothing novel about the process, except to the name by which they have defined the compound formed in the juice.

CULTIVATION AND MANUFACTURE OF SUGAR IN EGYPT.

IN November last I was one of the guests of H. H. Ismail Pasha, and was present at the inauguration of the Suez Canal. After all the festivities in Cairo were over H. H. supplied us very courteously with comfortable means of conveyance for a trip to Upper Egypt, recommending us on our way up the Nile to visit his favourite sugar factory at Rhoda. We had an exceedingly pleasant excursion and on our way down the river our steamer stopped at Rhoda, where we went ashore. When arrived at the factory I was very kindly shown round the works by one of the engineers, a European, who has been employed by H. H. for several years. I made use of this opportunity to gather all the information I thought necessary for an article, which may be of some interest to the readers of "*The Sugar Cane.*" Being a subscriber to the magazine, I had read some time before my visit to the country an article on "Sugar Cultivation in Upper Egypt," translated from the French of M. About, and though I cannot agree with all M. About's statements, I think he had a right to say, or rather to make his friend the "fellah" say "that this branch of agriculture and industry required considerable reformation."

The cultivation and management of this part would I think be better in the hands of an experienced sugar planter, acquainted with the theory as well as with the practice of growing sugar, than in those of the "mouffatich" of the district, who in general knows very little about sugar planting and thinks the best way of carrying it out is to follow the system of 500 years ago.

It is true that the Egyptians bury the whole of a cane for planting in again and that the rows are little over 2½ feet apart, which is of course very absurd for the reasons stated by M. About. Their system of irrigation also is very injurious to the cane and I found the canes which were laid in the yard behind the factory very tall and thin and apparently over-fed with water. It would be a great saving also if the tops of the canes were cut off before

grinding and they were kept for seed, as one of the engineers found by an experiment with a small hand mill that the cane tops reduced the average density of the juice to $8\frac{3}{4}°$ Baumè while the juice extracted from the body of the same cane shows 10°B. The juice not only gets poorer in saccharine substance but also contains more glucose, and a larger quantity of lime has to be used in the defecation. An experiment made this year in Rhoda showed that the scum taken from a 300 gallon clarifier weighed $3\frac{1}{2}$ cantars (3 cwts).

I was also told by one of my friends in Cairo that the size of the canefield was estimated at 3000 feddans, (about 3000 acres) though in reality there were about 4000 feddans planted this year. There were reasons why the "mouffatich" had a smaller number of feddans on the books than was really ground this year. The cane in Egypt ratoons once, and after the second crop is taken off the soil is planted for one year with grain or is left fallow. Some canes are richer the second year than the first, though there are instances to the contrary.

In some parts of Egypt the canefields are ploughed by steam ploughs, while in several other districts they still frequently use the old Egyptian plough drawn by oxen. The cane is transported to the mill by 3000 camels and as many fellahs to guide and unload them, and the cane from the fields which are close to the river side is transported in boats which are towed up or down by a steamer. I have seen cane lying in the yard behind the factory which had been cut more than three or four days, but the Arabs think nothing of that; and I was told that the Viceroy wishes to extend his canefields still further and transport the cane on railways, but I doubt whether it will be wise to adopt this system of transportation in Egypt. It appears to me that it would be far more profitable to erect two or three factories of medium size in a district instead of building *one* factory able to take off the crop of 4000 feddans of cane.

The country labourers ("fellahs"), though M. About says they get one piastre and a half a day, very often don't receive any pay at all, and I was told they had to find their own food while

working for the Viceroy, but whether his highness is acquainted with this fact I don't know; I can scarcely believe it, as one of the objects of Sir Samuel Baker's expedition to the sources of the Nile is to abolish slavery. I have reason to believe that some of the slaves in Cuba and in Brazil are better treated than the Egyptian fellahs, and I think that transforming Upper Egypt into a sugar mine as M. About calls it, would bring the "fellahs" to perfect misery, as there would be no land and time left to them to cultivate grain, and support themselves in that way. The common workmen in the factory are paid from two to five piastres a day, which payment they have very often to take partly in the shape of molasses. The mechanics and other better class of workmen get sugar instead.

Going through the works, I saw the sugar boiled in 11 vacuum pans in the main part of the works, and on two of Fryer's Concretors in another part of the building. The juice for the apparatus was supplied by two 5ft. and by two 6ft. canemills, made at Messrs. Forrester and Co.'s, in Liverpool. The juice was clarified in 36 double-bottomed steam clarifiers, holding 300 gallons each, and in three tubular clarifiers of 600 gallons each. From the clarifiers the juice was sent through the bag filters and then through the charcoal filters. The charcoal filters are 18ft. high, and are supplied by charcoal from a re-vivifying kiln belonging to the works. The fresh charcoal is also made on the spot, at a short distance from the factory. The charcoal is taken out of the filters after it has been used twice. One day it filters the syrup after the first boiling, and the next day it filters the juice. You will observe by this that the juice runs twice through the charcoal before sugar is made from it.

To the works is also attached a distillery, where a kind of spirit is made from the scum of the clarifiers and from the cleanings of the factory.

Some of the vacuum pans were boiling sugar for 16 centrifugal machines, and some were boiling for the sugar moulds. The centrifugals produced about 50 per cent. of very nearly white sugar of a large grain; but the sugar moulds after draining in the usual way, without claying, had to be refined over again after the crush-

ing of the cane was finished. The molasses from the centrifugal machines and from the moulds were not boiled over again, but were intended for sale in Cairo. In the Concretor factory adjoining the main building, where this apparatus was working on trial, I saw a different process altogether, and was much surprised by the results obtained there. I had heard of Fryer's concretor before, but had never seen it at work, and what I saw of it by far surpassed my expectations. The sugar was of a good colour (equal to No. 12 D. standard), the process was simple, and the working expenses seemed to me very trifling, especially in Egypt where labour is very cheap for the Viceroy. After leaving the works I was quite convinced that making raw sugar would be far more profitable to the Viceroy than the manufacturing of white sugar. *I was told* that besides the straw and megass, they burned every year 70,000 cantars of coal for making about 100,000 cantars of white-looking sugar, and that coal costs in Rhoda at least four times as much as it would cost a refiner in Liverpool.

While in the Concretor factory the engineer, who was superintending the working of the new apparatus, had the kindness to show me his journal in which he booked the working hours, number of gallons of juice evaporated, the quantity of sugar produced, etc., and I found that they were operating with the two Concretors on a little over 1000 gallons of cane juice of $8\frac{3}{4}$°B. per hour, and that they had made 1·8 lbs. of concrete per gallon from juice of this light density. I thought that was doing exceedingly well. They burned only megass, and consumed in the two furnaces about 22 cart loads in 12 hours.

In the Concretor factory I also saw 70 barrels which were very near full of concrete, and which next day would be ready for shipment. I was surprised to find that no molasses drained from these casks, a sight far more encouraging to me than the heaps of molasses jars lying in front of the works on the river side, and which looked very much like the battery of some fort; but I consoled myself with the idea of their contents not being very dangerous.

The crushing of the cane and the driving of the two little Concretor engines did not amount to 30-horse power.

L.

ON THE ABSORPTIVE POWER OF SOIL.

BY ROBERT WARINGTON, F.C.S.

(From the Chemical News.)

(Continued from page 338.*)*

BEFORE discussing the explanations that have been offered by Way and succeeding investigators of these remarkable properties of soil, it will be well to put the reader in possession, as far as possible, of the facts connected with soil absorption, which have been gradually accumulated.

All soils seem to possess this property of removing certain bases and acids from solution. The faculty is not confined to one class of soil, but is enjoyed by all the varieties of clay, marl, loam, light sand soil and peat soil. The faculty is not, however, possessed by all soils in the same degree, some soils exhibiting a very considerable absorptive power, while the capabilities of others in this direction are but small. Again, soils differ in their behaviour towards the different classes of salts: two soils that are equal in absorptive power for free ammonia are not, perhaps, equal in their power of absorbing sulphate of ammonium. It was shown, in Way's experiments, that the lime contained in soil took an important part in the action of soil upon sulphates, nitrates, and chlorides—a fact which has been abundantly confirmed by other researches. We can, therefore, easily understand that the presence or absence of lime, and of substances playing a similar part, must materially affect the absorptive power of soil for certain salts.

It must not be supposed that the salts named above, as used in Way's research, are the only substances which soil is capable of absorbing. If sewage or liquid manure be passed through soil, it will be found that nearly the whole of the organic matters held in solution have been removed—the offensive sewage will have become clear water. Here we have a large class of bodies, of which chemists know very little, which soil is clearly capable of absorbing. Again, there can be no doubt that the same action which determines the absorption of potassium or sodium would

equally determine the absorption of the rarer alkaline metals—lithium, cæsium, and rubidium; or that the salts of the other metals would generally be found to undergo, in contact with a soil containing lime, a similar change to that which sulphate of magnesium and other salts are known to undergo. The list of substances that come under the power of soil absorption is, in fact, a very large one. Chemists have, however, done wisely in concentrating their study upon the commoner salts of those bodies which are known to be an essential part of plant food, and are consequently always present in fertile soils. An acquaintance with the action of the soil towards these bodies is most important, and they have naturally received the chief share of attention.

Different bases are not equally absorbed by soil. Few experiments have, however, been made that allow of an exact comparison. Way found that a clay, treated respectively with chloride of ammonium and nitrate of potassium (the salts being used in the proportion of their chemical equivalents), took up a larger percentage of the ammonium than of the potassium, although at the same time, a greater quantity of the potassium was absorbed. In experiments by Küllenberg,* in which each salt was also used in its equivalent proportion, the bases were taken up by the soil in the following order, regard being had to the proportions of the equivalent absorbed:—ammonium, potassium, magnesium, calcium, sodium. The absorptive energy of both soil and clay was thus, from a chemical point of view, greatest for ammonium.

Not only is there this difference with regard to various bases, but experiment has shown that a base is not equally absorbed by soil from its various salts. The hydrate, the phosphate, and carbonate appear to be the salts from which the soil takes up the largest quantity of base; while, from the sulphate, nitrate, and chloride, the soil generally removes a notably smaller quantity.† Of the last three salts, the greatest absorption is usually from the sulphate. Only a few series of experiments have been published in

* *Jahresbricht der Agrikultur-Chemie*, 1865, p. 15.

† Some soils appear capable of removing about equal quantities of ammonia from solutions of free ammonia and of the three salts just named.

which the behaviour of the same soil towards various salts is fairly compared. It is essential, for such a purpose, that the solutions of the various salts employed should each contain, not the same proportion of salt to water, but the same proportion of *base* to water—that, in fact, each salt should be used in the proportion of its chemical equivalent. It is also necessary that a constant proportion be maintained between the weight of soil and the volume of salt solution throughout the experiments. The earlier experiments on soil absorption were not made with this exactness. Küllenberg has recently published an elaborate series of experiments upon one soil, employing each salt in its equivalent proportion, and in five states of dilution. Taking the total absorption in each five experiments as representing the absorptive power of the soil for the particular salt employed, and calling the greatest absorption in each series 100, we have the following as the proportion in which the bases were removed from their various salts:

Comparative Absorption from Different Salts of the Same Base.

[The greatest absorption reckoned as 100.]

	Ammonium.	Potassium.	Sodium.	Magnesium.	Calcium.
Phosphate	100	100	100	—	—
Carbonate	62	95	85	—	—
Sulphate	56	72	48	100	100
Nitrate	48	58	53	84	64
Chloride	45	57	60	81	81

We see that, in every case, the soil retained most base from the solution of the phosphate and carbonate, and that the sulphate stands next highest, except in the case of sodium. Henneberg and Stohmann,* experimenting on a garden soil with salts of ammonium, found the absorption of ammonium from the various salts to be in the following order:—Phosphate, hydrate, sulphate. The absorption from the chloride and nitrate was about equal, and the smallest of any. E. Peters† found the following order of absorption with salts of potassium:—Phosphate, hydrate, carbonate,

* *Jahresbricht der Agrikultur-Chemie*, 1858-9, p. 25.

† *Ibid.*, 1860-1, p. 9.

bicarbonate, nitrate, sulphate, chloride. Fraas,* using lysimeters as the vessels for his experiment, found the absorption of potassium salts to be in the order of carbonate, sulphate, nitrate. The only experiments I know of respecting the absorption of phosphoric acid from its various combinations are those of Küllenberg, forming part of the series already referred to. He employed the phosphates of potassium, sodium, and ammonium, and found the proportion of acid removed by the soil from these salts to be as 100 for the potassium salt, 87 for the sodium, and 68 for the ammonium. The whole of this branch of the subject requires further research.

The quantity of a substance which a soil will take up when shaken with a solution of it, is found to depend very much upon the strength of the solution. The following rule has been thoroughly established by a number of observers:—Soils remove the greatest proportion of base from a salt solution when that solution is weak, but they take up the greatest quantity when the solution is strong. Thus, in one of Küllenberg's experiments, 100 grms. of soil took up 0·2369 grm. of potash from a solution of the sulphate, while from a solution of 1-5th the strength the same weight of soil only absorbed 0·0977 grm.; but in the first case only 21·1 per cent. of the total potash was taken up, while in the last the absorption was 43·8 per cent. The first part of this law probably holds good only in those cases where, as in the experiments from which it is deduced, the salt is in excess of the soil. A strong and weak solution poured in each case upon an excess of soil would, we conceive, have their salt equally removed, unless, indeed, the stronger solution was so concentrated that it failed to moisten the bulk of soil necessary for its absorption. It is said, by many investigators, that a soil never removes the whole of a substance from solution. This may, perhaps, be true when taken in its absolute sense. The proportion of the salt removed must, however, greatly depend on the volume of soil employed. If, as in most experiments, the soil is shaken up with four or five times its bulk of liquid, a notable quantity of the salt will remain unabsorbed; but, if the soil be used in excess, and the liquid filtered through it,

* *Ibid.*, 1861-2, p. 11.

as in Way's original experiments, the absorption of ammonia, potash, and phosphoric acid will be found to be all but complete, minute traces only appearing in the filtrate; a fact amply attested by the analysis of drainage waters from cultivated fields.

The bases absorbed by soil are, to some extent, given up again when the soil is treated with water. Voelcker found that a soil which had taken up ammonia from solutions of the hydrate, sulphate, and chloride, gave back again half of the quantity absorbed when washed from four to seven times with four times its weight of water, the water remaining in contact each time for several days. E. Peters found that a soil which had absorbed potash, gave up about one part of potash to 30,000 of water, but that the potash was much more soluble in water containing carbonic acid. The information we have on this head is very scanty; more experiments are much needed.

A further point that has been noticed respecting the absorptive action of soils is the displacement of one base by another, We have already seen, in Way's experiments, how the absorption of ammonia or potash from their salts is generally attended by the separation of lime from its combination in the soil. In the same way, a soil saturated with ammonia gives up a part of its ammonia when treated with a potassium salt, and potash to some extent replaces the ammonia in the soil. This action, too, has been but little studied, though practically of great importance. Voelcker has pointed out that the beneficial action, upon some soils, of common salt may be owing to the displacement, by the soda, of some of the more valuable constituents of plant food which the soil contains.

We have now to consider the various explanations which have been offered of these remarkable phenomena of soil absorption.

In Way's first paper, no attempt is made to establish a theory respecting the absorptive power of soils. He plainly states that he considers the operation a purely chemical one, and hints that the absorptive faculty resides in some constituent of clay. He shows, by experiment, that ignition of a soil or clay greatly diminishes its absorbing power; that treatment with strong acid till all soluble

matter is removed fails to extinguish the absorptive power, though more or less diminishing it. In his second paper, Way describes a series of experiments with certain artificially prepared hydrated double silicates, which satisfied him that it was to the presence of such compounds in soils that their absorptive power was to be attributed. Way took a solution of silicate of sodium, and poured it into a solution of alumina in sodium; the precipitate that formed was a double silicate of aluminium and sodium. This compound, if treated with lime-water, or a solution of any calcium salt, gave up soda and absorbed lime. The resulting double silicate of aluminium and calcium, if treated with a salt of potassium, gave up lime and absorbed potash. If the sodium, calcium, or potassium salts were treated with a salt of ammonium, they gave up soda, lime, or potash, and absorbed ammonia. In fact, as far as the experiments went, all the principal features which mark the absorption of bases by soil were displayed in still greater energy by these artificially prepared silicates. The affinity of the silicate of aluminium for bases appeared to be greatest for ammonia, and least for soda; salts of ammonium would decompose any of the other silicates. The silicates of aluminium and calcium had the power of absorbing ammonia gas from the atmosphere. All the silicates possessed a very considerable degree of insolubility.

The explanation of the absorptive action of soils put forth by Way has not met with unanimous acceptance among agricultural chemists. It would be tedious to narrate the views and conclusions of each experimenter, founded as they are in many cases on very limited data, but we may point out the principal divisions of opinion.

Way's opinion that the absorption by soil was a result of the chemical combination of the substance absorbed with some constituent of the soil, has been, on the whole, generally shared by subsequent experimenters. Some, as Rautenberg and E. Heyden, have supported Way's theory of silicates in its entirety, and have sought to show that the absorptive power of a soil is in proportion to the amount of silicates (decomposable by the alternate action of hydrochloric acid and carbonate of sodium) which it contains; others, as Knoep and Voelcker, while not denying the absorptive power of silicates, have pointed to the hydrated oxides of iron and

aluminium as a further and important source of the absorptive energy of soils. Others, again, have experimented with the organic matter of soils, that assemblage of little known bodies that usually goes by the name of humus, and have shown that it, too to some limited extent, possesses absorptive powers.

Besides these opinions, all of which take a chemical view of the question, we have the wholly different view put forth by Liebig, who considers that the absorption of the various substances by soil is not in any way a result of chemical combination, but is merely a consequence of the "physical attraction" of a highly porous body. We are referred to the well-known power of charcoal, of removing certain substances from their solution in water, in consequence of which property it is so largely used as a decolorizing agent. The ordinary process of dyeing is quoted as another illustration of the same action; where certain organic colouring matters are removed from solution by the vegetable or animal fibre and remain very permanently united to it. We are told there is in these cases, no chemical combination between the absorbent and the substance absorbed, that the action is the result of mere physical attraction, and that the absorbent powers of soil are nothing more than a manifestation of the same action towards certain inorganic salts. It will be as well to state the view taken by Liebig in his own words*—

"There can be no doubt that all the component parts of arable soil have a share in these properties, but only when they possess a certain mechanical condition, like wood or animal charcoal; and that this power of absorption depends, as in charcoal, upon a surface attraction, which is termed a physical attraction, because the attracted particles enter into no combination, but retain their chemical properties.

"The term 'physical attraction,' as used here, does not signify a peculiar attractive force but merely designates the ordinary chemical affinity, which shows differences of degree in its manifestation."

* "The Natural Laws of Husbandry," pp. 67—69.

NEW SORT OF MANURE MADE FROM THE RESIDUES OF DISTILLATION.

BY M. B. CORENWINDER.

(From Le Journal de l' Agriculture).

THE continual progress of agriculture in all civilised countries and the impulse which has been given by science to this important branch of human industry has directed the attention of chemists and manufacturers towards the means of adding to and increasing the agents for fertilising the soil.

Amongst these agents there are great numbers which are worthy of special attention; amongst them are the residues of factories in which substances are worked from the animal and vegetable kingdoms.

For a long time past agriculture and manufacture have been intimately connected by the services which they have been called upon to render to each other. From the manufacture of oils there has been restored to the soil during the past century under the form of oil cake, the nitrogenous matters contained in the grain (rape seed, &c.). The operations of the distillery and of the sugar manufactory leave residues of which the agriculturist gladly avails himself. He cultivates the beet root particularly with a view to obtaining the pulp which the manufacturer rejects.

This dependence will in the future extend in proportion as the cultivator shall feel the necessity of drawing part of the various elements of fertilization from the materials placed within his reach by commerce and industry.

Never has the need been more urgent to make the earth produce abundant crops than at the present time, and this need will continually increase. It is important then to find new resources, not only to augment the supplies we have at present, but also to replace those fertilising substances with the loss of which we are threatened.

The efficacy of chemical manures, such as sulphate of ammonia, phosphate of lime, nitrate of soda, and the alkaline salts in general has long been demonstrated, particularly by MM. Liebig and

Kuhlmann. These manures have been much used for years past, both in England and Germany. They are beginning to be appreciated in France, thanks to the zeal, the advocacy, and the experiments of M. G. Ville, to whom belongs the honour of having introduced them into the practical agriculture of this country.

Unfortunately it is easy to foresee that this resource will always be limited. If the use of chemical manures becomes very general their mercantile value will become too high for the services they are capable of rendering. Indeed although we have not got beyond the experimental trial their price has greatly increased.

According to the most authentic accounts which have reached Europe, it is very probable that in a very few years the guano deposits of Peru will be exhausted. We know it is true that there are other resources, but no other it appears where the guano is so rich in nitrogen as that which our agriculturists have been in the habit of using, and consequently it will be of less use.

That it is not a feeble resource which we shall lose when the supplies of guano fail us from Central America will be seen by the following table extracted from the Custom house returns, which will show the quantities of this species of manures imported into France in the three given years :

	1868.	1867.	1866.
Belgium	2,599 tons.	1,893 tons.	2,724 tons.
Peru	94,160 ,,	91,280 ,,	43,751 ,,
Other countries ..	304 ,,	936 ,,	575 ,,
	97,063	94,109	47,050

The sugar manufacturers certainly will not complain of the disappearance of guano, which has a bad effect on the beet root with regard to the poorness in sugar and to the difficulties of working which it produces. But the agriculturist will see with regret, the prices of all descriptions of oil cakes advance for which they have a too exclusive predilection and which already cost more than they are worth.

With this prospect then it is important to make the most of all animal or vegetable matters, the residues of destroyed organisms

which may be met with in those manufactories which use substances of an organic nature. In this respect much remains to be done.

Impressed with this truth I wish to draw the attention of practical men to a residue obtained in a factory of Pas de Calais in which maize is distilled, the sugar being extracted from the starch contained in it by means of acids.

The distillation of maize has during the last two years given rise to a considerable importation of this cereal, chiefly from the Black Sea and the Danubian Principalities. From the Customs' returns this import has greatly increased in the three years given below:

	1868.	1867.	1866.
Southern Russia..	140 tons.	552 tons.	682 tons.
Belgium	130 ,,	..	..
Italy	3,450 ,,	1,214 ,,	368 ,,
Turkey	2,875 ,,	1,360 ,,	2,705 ,,
Other countries ..	4,580 ,,	460 ,,	780 ,,
	11,175	3,586	4,535

A great proportion of the increased imports of the last year has been employed in the distilleries. In most of these factories the crushed grain is boiled with acidulated water by which its starch is transformed into sugar. The excess of acid is saturated with chalk, the wort is fermented and the alcohol separated by distillation.

This process of manufacture has one serious inconvenience, it is this, that the residues of distillation are not suitable for feeding cattle, like those obtained from the fermentation of the starch of other grain when malted.

In the hope of materially lessening this loss MM. Tilloy Delaune and Cie., distillers, of Courrieres, Pas de Calais, conceived the happy idea of extracting the nitrogenous matters contained in the lees after the alcohol is separated.

For this purpose when distillation is finished the residues are cooled in cisterns, then allowed to stand some hours, when the greater part of the nitrogenous matters are precipitated, and the clear liquid is then decanted.

The deposit first spread out in the air and afterwards dried by heat presents the appearance of a dryish powder of a blackish grey colour, the carriage of which is of course very easy.

M. E. Pfeiffer a skilful chemist has made several analyses of this product, the average result of which is as follows :—

Water		8·77
Organic matters	68·35	
Nitrogen	4·30	
		72·65
* Phosphate of Lime	2·21	
Chloride of Potassium	1·90	
Sulphate of Potash	3·05	
Carbonate of Potash	1·13	
Carbonate of Soda	1·68	
Carbonate of Lime and Magnesia	2·63	
Sand, Silica	5·98	
		18·58
		100·00

Nitrogen in 100 grammes of dry matter 4·70.

Below is my own analysis of the same matters.

Water		8·50
Organic matters	69·54	
Nitrogen (average of two analyses)	4·26	73·80
Mineral matters		17·70
		100,00

Nitrogen in 100 parts of dry matter 4·74.

From these analyses we may conclude that the manure extracted from Maize at Courrieres (Pas de Calais) possesses a fertilising value which recommends it to the attention of agriculturists. In fact its richness in nitrogen approaches that of oil cakes which often contain less than 5 per cent. It also contains a very notable proportion of phosphates, of salts of potash, elements which unite with nitrogen in the nutrition of plants and enter into the constitution of all complete manures.

* The greater part of these salts are from the beet. In the usine of Courrieres maize wort is distilled along with molasses.

This manure is already becoming known and has proved very favourable to the growth of beet, which being manured with it has produced a very satisfactory crop. It has another good quality which deserves notice. As it is produced from matters which have been submitted to the action of heat the seeds of weeds which may be mixed with the maize have lost their germinative power. This is a peculiarity not to be despised, for it is well known that certain manures introduce into the soil the seeds of noxious weeds.

THE SUGAR DUTIES IN FRANCE.

Petition presented to the French Ministre de l' Agriculture et du Commerce, relative to the reduction of duty on sugar :—

Monsieur le Ministre,

We, the undersigned, beet farmers, planters, sugar manufacturers, shippers, and merchants, respectfully solicit the appointment of a Commission for the purpose of considering a reduction of duty on sugar in France.

The duties in England have just been reduced one half and contrast with ours in the following manner :—

	England.			France.	
Sugar, refined	6	0	per cwt.	19	1
,, white	6	0	,, ...	18	4
,, Nos. 15 to 18 ..	5	8	,, ...	17	10
,, Nos. 10 to 14 ..	5	3	,, ...	17	1
,, Nos. 7 to 10 ..	4	8	,, ...	17	1
,, below No. 7	4	0	,, ...	17	1

Sugar has become an article of food of the first necessity, and cannot remain burdened with duties amounting from 80 to 100 per cent. of its value, especially as our country already produces more than its consumption, which is thus limited by excess of taxation.

We are aware how difficult it may appear to reconcile an immediate and considerable reduction with the exigencies of the budget, but we are persuaded that although the attempt at reduction in 1860 was abandoned, yet the circumstances of the case are now quite altered on account of the increase in French production in proportion to the utmost consumption at present possible.

We have the honour to be, &c.

OBSERVATIONS ON THE CIRCUMSTANCES WHICH FAVOUR THE MODIFICATION OR THE PRESERVATION OF CRYSTALLIZABLE SUGAR.

By M. Dubrunfaut.

It is well known that we have been occupied in scientific researches and in works of a practical nature on sugar and alcohol for many years past, and that many facts which we discovered have been indirectly given to the world through chemists and manufacturers with whom we have been brought in contact and to whom we have freely imparted the results of our observations.

Thus the transformation to which sugar submits during fermentation we noted as far back as 1828, and it was published in 1833 in a work on chemistry by M. Baudiment, to whom we imparted it and who gave it under our authority. Perhaps it may be of use to recall the circumstances which led to this observation.

A refiner of Gand, whose name we forget, being unable to crystallize a syrup proceeding from some loaves, sent us a sample from which we found that the sugar contained in it had submitted to some modification; and it occurred to us that the store rooms of old sugar refineries always had an intense odour characteristic of fermenting cellars, and that the droppings from the loaves always gave indications of alcoholic fermentation, so that we suspected the syrup in question had been modified by this means.

To verify our suspicion we prepared a solution of pure sugar of 9° or 10° Baumè, and added to it the proportion of yeast which would have been used in beer, and placed the wort in a stove at a temperature of about 80° Faht. The wort soon fermented very briskly with considerable disengagement of carbonic acid At this moment we arrested the fermentation by boiling the wort, and having clarified it by albumen and filtration, as in refining, we concentrated it to crystallizing density; left for some time in the stove no crystals of sugar appeared, but allowed to stand much longer and exposed to the air, glucose sugar separated, as would have been the case with syrup from grapes under the same conditions.

This experiment clearly proved that the first effect of fermentation on cane sugar before the formation of alcohol is to transform it into saccharine substances analagous to those contained in the must of over ripe grapes. We have since discovered that the syrup formed on these conditions is identical with what is called after M. Biot *inverted sugar*, the same as is obtained (from cane sugar) by the action of acids, which comparable to properly formed grape sugar and contains two distinct species of sugar, right handed glucose, dextrose, and left handed glucose or the levulose of M. Bouchardat.

In making known these results to the refiner who had sent us the sample, being even then aware of the preserving effects of lime, we recommended him to employ this agent as a remedy, either in the rinsing of his receiving vessels or the clarification of his syrups, and we afterwards learnt that he had taken our advice with great benefit to himself.

Perhaps it may not be uninteresting to those concerned in the sugar industry if we also recall the conditions under which we discovered the use and functions of lime.

Being occupied about the year 1820 with the refining of sugar candy (from colonial sugar exclusively,) we observed that the clarification effected with fine animal charcoal and blood produced such an amount of froth during the working that it was needful in order to prevent its running over the copper sides to have the capacity of the coppers nearly doubled by means of moveable sides which old refiners will remember. The cause of this great amount of froth appeared to be the disengagement of carbonic acid, the presence of which was due to the sugar having submitted to alcoholic fermentation during transport, which was very evident from the odour especially in low qualities. This suggested the remedy and we did not hesitate to employ it.

The sugar being dissolved for clarification, before adding the charcoal and the blood it was raised to boiling point and the lime added either in fine powder or in milk of lime, being thrown into those parts of the copper where the bubbles most appeared, until the syrup boiled without continual frothing, the point being easily

found by feeling our way in the gradual manner of adding the lime. The fine charcoal was next added, then the blood and the clarification proceeded with in the customary manner, the only difference being that the moveable sides of the copper were not needed. The lime acted as an absorbent of the carbonic acid gas and its purifying effects on the syrup was not the less apparent; in fact the filtered syrups were perfectly clear and they submitted to boiling and crystallization without frothing with the use of the smallest quantity of grease.

Another remarkable peculiarity was shown in the quality of the produce, the sugar candy made in this manner being very superior. The crystals were large and angular much detached and perfectly clear, whilst those made without the use of lime from the same sugar were more or less opaque and in large groups. This mode of refining which was a real alkaline working was perfect in all points and the syrup produced in it was worked without difficulty and without the addition of any more lime.

There was another observation connected with the question which now occupies us, which we had occasion to make in the laboratory in 1828, about the time when we discovered the transformation of crystallizable sugar into glucose under the influence of yeast.

Having seen the need of graduating an areometer by points, we had prepared a series of solutions of pure sugar of various densities from 5 to 30° Baumè, which solutions having served the end intended were allowed to remain in flasks badly stoppered.

Nearly a year after accidentally observing them we found with surprise that with one exception (of a density of 15° Baumè,) they were all altered. They had become sensibly coloured, were acid, contained much mucus and other parasitic matter. By clarifying and concentrating them we found that they refused to crystallize, but *mamelons* of glucose were easily formed, this with other facts showed that mixed with water only crystallizable sugar became modified in the same manner as when under the influence of yeast.

The only solution preserved intact and uncoloured was sensibly

alkaline, and being concentrated by simply boiling, it crystallized just the same as a pure sugar solution would have done. It was evident that this wort owed its preservation to the presence of a small proportion of alkali accidentally mixed with it and which had sufficed to preserve the sugar perfectly about a year, though in the state of dilution named (15° Baumè). To verify this we feebly alkalised a sugar solution and keeping it in the same sort of flask found it unaltered after a long period.

In the remembrance of these various facts we have never ceased since this period to recommend lime as the preserver and defecator *par excellence* of crystallizable sugar and its syrups, and with this conviction we have argued against the neutral working practised by many manufacturers from 1849 to 1855, and with the same conviction that we have protested these five or six years against a direction given by inventors to the mode of working in the making of sugar which we deem erroneous.

It is strange that we have now to rectify against the same inventors some very opposite tendencies to those they formerly favoured. Thus some chemists, who shall be nameless, who in 1849 and 50 defended the neutral working, under the vain pretext of the destructive effect of lime on pure sugar affirmed by the English chemist Daniel; to justify the illegitimate invention of carbonatation, have placed themselves at the very opposite end of the scale, and advocate an invention which consists in solidifying the syrups by lime to facilitate their transport and to separate the sugar afterwards by the carbonic treatment. The inventor of this scheme proposes to do for the beet sugar *Agricoles* what we proposed in 1850 for the colonial sugar industry for the produce intended for transport to Europe, but at that period we were, as always, consistent with ourselves and our principles in defending without reserve the alkaline working as applicable to the colonial sugar manufacture.

In fact, in the patent in which we proposed to solidify the colonial syrups with lime in such manner as they could be moulded into blocks like stones and transported without package of any sort, we ventured a prediction which may yet be realized, viz. :—That the colonial sugar industry would be saved the day when adopting

the alkaline working it should decide to send its sugars and its molasses in an unedible state.

We can understand from the facts given above how a distinguished *savant* of high chemical reputation should in 1857 ask for a patent to preserve the juice of beet roots by lime, and rest his application on the discovery that pure sugar being formed into inverted sugar when diluted with water, that the beet roots themselves are deteriorated in quality during the few months which it is necessary to keep them, on this principle. To avoid this he proposed to rasp and press the whole crop of beets immediately as it became ripe and to preserve the limed juice in gigantic cisterns.

If we had the honour to be consulted by the inventor who has drawn on our principles we should point out to him the quantity of rasps and presses required to realize his idea and the cost of the cisterns. The only peculiarity of value which we see in his invention if the economical question had justified its adoption is that it would have permitted the extension through the year of a manufacture now confined to 100 days.

Additional note on the Icery Process. This process having been at one time the subject of a *critique* on our part founded on preconceived ideas we have thought it our duty to rectify what was too absolute in our *critique*, and we do so by means of material facts which have been placed in our hands. We think it best to publish these facts here in order, that the reader may form an opinion therefrom.

M. Thomas Lory, of the house of Lory Brothers, proprietors of the sugar estate of Ravine Glissante (in the isle of Reunion), has lately sent us three samples of sugar Nos. 1, 2, and 3. The first two were produced by the Icery process, practised at the establishment of Constance Mauritius, *i.e.*, by the mono-sulphite method of defecation and the most perfect apparatus. No. 3 was from the manufactory of M. Lory who works by the old process, that is, defecation by lime, evaporation over the open fire in the Ginard battery, the Taylor filtration, concentration in the vacuum pan, drainage by centrifugal and drying in the sun, animal charcoal not being used.

The following are the results of the analyses of these three sugars:—

	No. 1.		No. 2.		No. 3.
Crystallizable Sugar....	100·430	..	99·730	..	97·280
Glucose or Derivatives ..	0·006	..	0·008	..	0·946
Ash	0·054	..	0·270	..	0·090
Lime	0·0228	..	0·256	..	0·0057
	Neutral.		Neutral.		Acid.

Thus we see here a sugar No. 1 which with the standard weight 16·35 grammes gives more than 100 per cent.* With our weight 16 grammes it shows 98 per cent., and No. 2 is also relatively very rich. In short all in these analyses is in favour of the Icery process; and if there is no error, *i.e.*, if the samples sent represent the regular results of the process it demands the attention otherwise called to it by the enthusiasm of the Mauritians and the high reputation of its inventor.—*Journal des Fabricants.*

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* The basis of polariscope analysis is obtained by dissolving 16·35 grammes pure loaf sugar and diluting it to the volume of 100 c.c.; a column 20 centimetres in length of this standard solution marks 100° on the polariscope. M. Dubrunfaut states that sugar which requires 16·35 grammes for the standard solution is not absolutely pure, and that of perfectly pure sugar 16 grammes is sufficient.

With regard to the purity of Nos. 1 and 2 samples, it should be borne in mind that in Mauritius, charcoal filters are used with the finer sugars; and in order to estimate the pecuniary advantages of Dr. Icery's process other data are needful besides the degree of purity of the sugar, some quite equal to these samples having been imported from parts where charcoal filters are used but where mono-sulphite of lime is unknown.—*Ed. S. C.*

THE PROJECTED ABOLITION OF SLAVERY IN THE SPANISH COLONIES.

A project of law was introduced into the Cortes at Madrid on the 28th of May for the gradual abolition of slavery in all the Spanish colonies, and it is said to have been favourably received. The following is the text of the proposed measure—

Art. 1.—All the children of slave mothers born after the publication of the present law are declared free.

Art. 2.—All the slaves born between the 18th September, 1868, and the publication of the present law are freed by the state paying to their masters the sum of 50 crowns for each.

Art. 3.—All slaves who have served under the Spanish flag or in any other manner have assisted the troops during the insurrection in Cuba are declared free. The State shall indemnify their masters if they have remained faithful to the cause of Spain, but if they have favoured the insurrection they shall have no claim to indemnity.

Art. 4.—The slaves who on the publication of the present law shall have attained the age of 65 years are declared free without indemnity to their masters, those who in the future shall attain this age shall enjoy the same advantage.

Art. 5.—All the slaves who are entitled to freedom, or who from any other cause shall belong to the State, shall enter at once into the full exercise of their civil rights.

Art. 6.—Those enfranchised under the present law under Articles 1 and 2 shall be under the patronage of the masters to whom the mother belongs.

Art. 7.—The patronage spoken of in the above Article imposes on the patron the obligation of supporting his clients, of clothing them, providing medical assistance, and giving them the education necessary to the exercising of some art or trade. On condition of the patron performing all these duties of tutelage he shall be entitled to all the profits of the labour of the freedman up to the age of 18 years.

Art. 8.—The enfranchised having attained the age of 18 years shall receive half the wages of a freeman to be paid to him at once, the other half shall be laid by as a reserve, of which further explanation follows.

Art. 9.—At the age of 22 the enfranchised will attain all the rights of citizenship and the reserve of his wages is then to be paid to him.

Art. 10.—The right of patronage is transferable as other rights. The fathers, legitimate or natural, who are free themselves, to be permitted to purchase the patronage of their children by paying to the patron, expenses incurred on their behalf. The basis of this indemnity to be legally settled.

Art. 11.—The superior civil governor shall make out within a month after the publication of the present law the lists of the slaves comprised in Articles 2 and 5.

Art. 12.—The enfranchised named in the latter of these shall be under the patronage of the state. This patronage to be confined to their protection, their defence, and the provision of means for maintaining themselves. Those who prefer to return to Africa to be taken there.

Art. 13. The slaves spoken of in Article 4 may remain in the house of their master, who in this case becomes their patron. When they shall have chosen to remain in the hands of a patron it shall be optional to the latter to pay them wages or not. But in all cases as in that of the physical impossibility of keeping themselves, their patrons must provide them with food, clothing, and medical assistance, and shall have the right to occupy them with labour compatible with their state.

Art. 14.—If the freedman removes himself of his free will from the patronage of his old master the obligations specified in Art. 13 cease with regard to the latter.

Art. 15.—The Government will provide resources necessary for the indemnities required by the present law by an impost on the slaves who will still remain unenfranchised.

Art. 16.—All endeavours to evade the application of the law will be punished according to Article 13 of the penal code.

Art. 17.—Each slave owner shall prepare a return of his slaves. Every individual not returned therein shall be free.

Art. 18.—The Government will draw out a special regulation for the execution of the present law.

Art. 19.—The Government is authorized to adopt all the necessary measures in order to realize the emancipation of those who still remain in slavery after the inauguration of the present law.

This measure, very important to the slaves in the Spanish colonies and to their masters, is not likely from the very gradual manner in which the emancipation of the children is to take place to have much immediate effect on the production of sugar in Cuba. The slaves above 65 who will be liberated and if so disposed will leave their masters' patronage will be comparatively few, and their labour either in the cane field or the boiling house not of much value. What measures the Government will consider necessary to realize the emancipation of those whom the present project of law does not touch and which comprises all the slaves from the ages of two years to sixty-five, except the slaves of rebels or the slaves who have fought under the Spanish flag, remains to be seen.

The Spanish government, unlike other European governments who have liberated their slaves, evidently does not contemplate putting the mother country to any expense in the matter, either by direct payment or by giving any fiscal advantages to their slaveholding colonies, the compensation to the planters for the slaves liberated, is it appears by Article 15 to be provided for by a tax levied on those who remain in slavery. This article, at least, is not likely to be popular with the Cuban planters, or to increase their attachment to the home government.

The *Journal des Fabricants* anticipating a great decrease in the production of sugar in Cuba in consequence of emancipation, which decrease would chiefly affect the United States of America, looks forward to the time when Europe will supply the deficiency, and when from France especially beet root sugar will be exported into North America; and the serious attention of French sugar manufacturers is invited to the market which is likely to open to their

produce: but we think it will be the fault of the cane planters of the West Indies, and more especially of those of Louisiana, if beet sugar ever becomes to any considerable extent an article of import from Europe into the United States.

There is no question, having regard to the experience of other colonies and countries, but that the emancipation of the slaves will eventually seriously affect the production of sugar in an island which now produces a very large proportion of the sugar consumed in North America and in the United Kingdom; but this emancipation being gradual there is time for the amount of sugar produced in other colonies to be proportionately increased. The prospect will doubtless act as a stimulus to the cane planters, of the West Indies and Louisiana particularly to endeavour not merely to increase the weight of their crops, but by suitable methods of culture and the introduction of new varieties, to increase the saccharine richness of the cane, as their rivals in Europe have done with the beet, and further by improved means of extracting the juice to obtain a larger percentage of what the cane contains than is generally the case at present. As regards the manufacture, experience will teach them under what circumstances it is most profitable for them to make fine sugars, and when it will pay best to aim at the largest return of sugar at the least expense of capital and labour.

THIS AND THE FOLLOWING LETTER ARE FROM THE "SYDNEY MORNING HERALD."

CANE OR SUGAR? WHICH?

Sir,

Are our farmers on the northern rivers, to grow *cane* or *sugar?* Are proprietors of sugar works to buy cane or sugar?

My meaning in these queries will appear from what follows: but to those who have been manufacturing sugar in New South Wales, they will be sufficiently significant.

It may be premised that, in the sugar industry as in other matters, unless we start and act upon correct principles, we shall inevitably go more or less wrong; and instead of reaping satisfac-

tion and profit we shall have disappointment and loss. In this colony the industry is yet in its infancy; and though it is progressing, its step is not yet stable and assured. If we are to prosper in it, it seems to me we must give more heed than we have yet done, to the guidance of principles and laws which are as inflexible as those of the Medes and Persians, and cannot be disregarded with impunity.

I have just seen a short article in one of your contemporaries, in which the planting of cane more closely together than at present is advocated in order to obtain a larger crop. But of what? Cane or sugar? If we want cane merely, I say by all means; if sugar, by no means. I take it that our aim is to obtain *sugar*, the matured product of the sugar-cane; and this we shall best do by acting in harmony with the well established principles of vegetable physiology—that light and heat are essential to the full elimination of the special products of plants. We do not, for example, expect aromatic gums and fragrant spices from climes where the summers are short and the winters long, and the skies much over-clouded; but in the blazing tropics, where the sun is hottest, and the light intensest, it is that the most choice and valuable elaborations of the vegetable world are brought forth.

So also with our plant, the sugar cane. Our rich alluvial lands will yield, by close planting, crops twice as heavy as those grown by tropical planters. But what of the commercial result of these in sugar? Do we get a double yield in the mill? Thus far my experience leads me to say, decidedly not. We grow splendid looking fields of cane, weighing at the mill yard from 40 up to 60 or 70 tons of dressed stalks per acre; but the yield of sugar is by no means proportionate. We have grown *cane;* we have produced more material to cut and thrash and handle, and cart and crush, and more megass or residue to carry away, or burn off, as sometimes is done. And all this means, more labour to be paid for, and proportionately less return to supply the means of paying.

But we have not stated the whole case. By close planting, and thus shutting out the sun's alchemy, that would have turned our

work to gold, had we not hindered it, we have not only been lessening our best friend, the true sugar, but we have been increasing our formidable enemy, the uncrystallizable sugar, or glucose; we have been actually preparing for our own perplexity, a needless excess of molasses for "each cane that is not perfectly matured, yields this intractable substance in great abundance." How *can* canes mature perfectly that are crowded thickly together, at least in these districts?

But it may be objected all I have advanced is mere theory. Even so, it is at least based on incontestable facts. What says experience? How are we to regard the following apposite instance from Guadaloupe?

"In 1849, M. Pauvert was simply a tenant, one that we call here 'a sucrote,' who produced a hundred casks of raw sugar."

"In 1869, he is the proprietor of four beautiful sugar estates, which produced nearly 2000 casks of white sugar.

* * * * *

"How has M. Pauvert arrived at this magnificent result? By a very simple process—so simple that we are now astonished that no one thought of it before him, a process which may be reduced to the following axiom:—If you wish for a large crop of sugar plant very few canes."

For the preceding reasons I confidently submit, as the answer to my first query, Are our farmers on the Northern rivers to grow *cane or sugar?* This pithy axiom: *If you wish for a large crop of sugar plant comparatively few canes.*

My second and kindred query is, Are the proprietors of sugar works to buy cane or sugar? That is mere bulk of cane of vegetable growth, irrespective of its saccharine richness. To do so would be to run counter to the guiding maxim in buying other sorts of raw produce; and this is, to pay a price according to quality. A merchant pays less for equal bulks of low class teas, coffees, flax, hemp, wool, sugar, and all other produce in general, than for the better qualities. Thus far a like practice has not obtained in New South Wales in the case of canes. It has been

bought by mere weight and bulk, almost irrespective of its richness or poverty in sugar. This course has I fear, done more harm than good. It has virtually put a premium upon faulty planting and defective culture: the extra bulk, non productive of sugar, has entailed loss by increased charges on both grower and manufacturer, especially the latter; and the pecuniary results of the season have been much below expectation. Hence one party is learning that cane buying is for him on quite a wrong basis, and the other that he must look less complacently on merely big, luxuriantly vegetated cane, and aim at superior quality, not at quantity alone.

I have just heard of a sugar establishment offering within the last few weeks 10s. per ton for cane. After some tons had been delivered the growers were persuaded to sell no more, save at an advance of 20 or 25 per cent.! This was refused and the mill was closed, wisely in my opinion. Taking into consideration the wet and cold of our late season, I am inclined to congratulate the proprietors on their probable escape from an unremunerative bargain; but I do not congratulate the growers on missing a profitable sale!

This is a sample of the controversy that must be settled between the settlers and buyers of cane. The expectations of the former have been perhaps unduly raised by over-sanguine estimates of the profitableness of sugar production, and hence the resistance to an approach to equitable terms. But these will be come at ere very long. Meanwhile the owners of sugar works to be safe, will do well to grow cane for themselves; but the farmers will also do well so to improve the cultivation of their cane pieces, as eventually to make it most to the interest of manufacturers to give up cultivation, and arrange for buying cane from the growers; and devote all their energies to the development and advancement of their various processes.

JOHN C. NIELD, M.D.

Port Macquarie, 8th April.

FRYER'S CONCRETOR AT WORK IN AUSTRALIA—RESULTS.

Sir,—Pursuant to promise, and because it may be of interest to many of your readers, I write to state concisely the results of working Fryer's patent Concretor as a sugar-making apparatus, during the late sugar season.

In the first place, however, let me say, I cannot get a good many people to comprehend that the Concretor can make sugar at all. Their preconceptions are fixed (or concreted) into an obstinate notion that the Concretor turns out concrete, and that it can turn out nothing else. Ocular demonstration fails to convince them. When shown a sample or even a ton of our yellow counter sugar, they remark, "Oh! that's concrete, is it?" Others to whom samples of our sugars have been sent, have decided that they could not have been made by the Concretor at all. Moreover, despite these sage opinions, the fact remains just the same, that, with Mr. Fryer's medium-sized Concretor, modified at my suggestion, I have made from 23½ acres of cane upwards of 60 tons of counter sugar, which has gone direct into consumption, exactly like battery sugar, and at equally good prices.

Of concrete, though able to make it if we wish, we have made none, save by accident. Now and then a little (not a hundred-weight altogether) has formed in one part of the apparatus.

It will be seen that the total of sugar made by us, about 64 tons from 23½ acres of cane, is not far below an average of 3 tons per acre. As our first seven acres yielded 22 tons, I think I am warranted in believing that 3 tons per acre all round would have been obtained, save for drawbacks mostly avoidable in future seasons. For example—

1st.—We were complete novices in sugar-making, working with an entirely novel apparatus, and having our requirements to ascertain; and, for want of some of these, we could not avoid wasting material, the utilizing of which would have largely increased our return.

2nd.—We have been greatly hampered by the extraordinary wetness of the season, and the consequent damage to fuel.

3rd.—Towards the end of our work we had to crush a great deal of fallen cane, which had not only been a long time down, but was growing vigorously from the eyes, to the manifest lessening of the sugar in the parent stalk, as well as to the equally evident increase of the glucose, or uncrystallizable sugar.

Our season, despite drawbacks, inconveniences, hindrances, and waste, has been a success. We have, throughout, worked to a profit. Our sugars have ranged here, and in Sidney, from £31 to £38 per ton; and in the matter of diminished working expenses, and turning to the profitable account material hitherto not utilized, we see our way to better things for the future.

I do not enter into details, as my purpose is merely to give general results. To parties who may be contemplating putting up sugar works, I can strongly recommend, from my own experience, the Concretor in preference to the battery, whether the latter be worked by steam or by the ordinary fire.

Yours, &c.,

JOHN C. NEILD, M.D., &c.

Port Macquarie, New South Wales, March 28.

THE MANUFACTURE OF SUGAR.

WE observe that *The Engineer* is publishing a series of articles on the sugar manufacture, in which a juster and more comprehensive view is taken of some matters connected with it than is often found in the columns of a newspaper, although there are some matters of detail not quite accurately stated and one or two errors, which may have been overlooked in the final corrections. The writer takes a reasonable view of the difficulties the planter has to contend with and states them very fairly. In the first extract we make the reason is given why raw sugar from the cane is often preferred to refined, and is so superior to raw sugars from the beet, the maple, &c. "When we pronounce on the identity of any two compounds

the assumption of course is—whether the assumption be latent or expressed—that the things compared are pure. If not pure, then if the impurities be not identical, one may be pronouncing on differences of impurity, not of the impure thing; contemplated thus one can easily understand how the opinion prevailed that sugar extracted from cane was radically different from the sugar extracted from the beet, and so on for the remaining sources. It so happens that such chemical impurities as cane juice yields (we use the word impurity in the chemical sense, as meaning an extraneous body,) are all aromatic and agreeable to the taste, whereas the impurities yielded by beet and maple juice are offensive to the nose and palate. All of us know that yellow or muscovado sugar, made from cane, is more grateful to some palates than white or lump sugar."

"The yellow sugars we meet with in English commerce are all derived from the juice of the cane. But the first stage of sugar yield, be the yielding liquid beet juice, maple, date, or any other juice save cane is yellow too, it can only be whitened by subsequent operation. The human palate however coarse or depraved, could not tolerate yellow or muscovado sugar produced from beet juice; it is altogether too offensive. Thus comparing two yellow sugars a difference might seem to exist, though really as we see, the difference is referable to the different characters of impurities. A similar remark applies to sugar of the maple and the date, but in a more restricted sense. The yellow sugar products of these vegetables are not absolutely disgusting to the human palate, but each has a distinctive smell and taste, not pleasant and aromatic like yellow sugar extracted from the cane. From these remarks the inference may be drawn that, whereas sugar extracted from the cane may be presented to commerce and enter into sale for immediate consumption for man, either as yellow sugar (which is sugar plus coloured impurities) or else as white or refined sugar, no like choice is presented in the case of sugar from the beet root. This merits consideration, as explaining how it happens that yellow sugar for domestic consumption has been almost entirely banished from France, Belgium, and Germany. Many English palates still relish home sold yellow or muscovado sugar. The great quantity

and extremely offensive nature of the impurities associated with the sugar of beet have stimulated and brought into action a proportionate number and variety of purifying resources; step by step the process of beet root sugar extraction and refining has been improved, until the manufacture has been brought to a grade of perfection hardly equalled by any other branch of manufacturing industry dependent on combination of mechanical with chemical resources."

The next quotation refers to the difficulties the planter has to contend with, we may premise that we do not quite agree with the writer's remarks on central factories, as there are circumstances under which, they may be, and indeed have been conducted with success.

"It will be instructive to pause now and consider under what unfavourable circumstances a colonial sugar grower is placed. He has to conduct a refined chemical operation under conditions most unfavourable. Obviously he needs skilled labour; his workmen should have both chemical and mechanical knowledge; but far too often he is obliged to put up with unskilled labour wholly, except in so far as the rule of thumb is to be acknowledged as skill. Negro labour it commonly is too—and when Sambo *is* unskilled he licks creation. The sugar grower has to deal with a juice that if left alone ferments before his eyes; if not left alone—if heated, and still more if heated in contact with lime, fermentation is stopped indeed, but destruction of sugar goes on. The case is indeed difficult. Many proposals have been made to limit the manufacture to central mills instead of conducting it in detail, each grower on his own estate; but a slight consideration of attendant circumstances will demonstrate the futility of the project. To ensure success, means of conveyance to the mill should be easy—cane should be small in bulk, and should not injure by keeping. These requisitions are all violated. Those persons who have advocated central establishments had corn in their mind; between corn and cane there is no analogy whatever. However desirable it theoretically may be to disassociate the growing of cane—an agricultural operation—from the manufacture of sugar—a case of two applied sciences, chemistry

and mechanism—we see no hope of amelioration this way, but fear the agriculture—the growing, the milling, and the boiling, which means to some extent spoiling, must be conducted on the same estate. The unfavourable conditions under which growers of cane sugar are placed have been fully gone into, for two reasons: First, to let sugar growers plainly see what amelioration to aim at. Secondly, to vindicate them from the often-brought charge of manufacturing incompetence. Whereas, cane juice holds not less than 16 per cent of real sugar usually, whilst beet juice holds considerably less than 10 per cent., it has often been wondered that beet sugar manufacture can be conducted at a profit. When, further the fact comes out that cane growers extract less than 10 per cent. from their juice, that coloured or impure beet juice producers extract within 1 per cent. of theirs out of a totality of not more than 7 per cent., the conclusion seems to be forced on the mind that cane juice working is prosecuted in a manner needlessly extravagant. So, indeed, it mostly is. There is much room for improvement, but still colonial sugar growers are placed under circumstances of disadvantage that leave them much excuse."

As will be seen the writer does not advocate the making of either fine sugar, or of muscovado exclusively, in the colonies, but shows that each has its advantages according to circumstances, the only point he insists on, is that if sugar is intended for refining at home, the simpler the process it is subjected to in the colonies the more profitable it is likely to be. The reference to the fiscal restrictions would lead to the supposition that the article had been written before the recent reduction in the duty had rendered these practically inoperative, as regards the quality of sugar produced in the colonies.

"It is worth while to remark here that the quality of a sample of sugar furnishes no criterion of the excellence of manufacture; inasmuch as quality may be the result of working by some barbarous process, heedless of destruction wrought, and recklessly cleansing away of an amount of molasses, the chief portion of which, under an adequate system of manufacture would not have been produced

at all. Quantity of sugar is usually a condition of greater importance in colonial working than quality. On this head it is difficult to establish a general rule for all colonies. Scarcity of water in some, of coal fuel in others, prevent the use of animal charcoal and the vacuum pan; whereas in other colonies more favourably situated as to coal and water, the facilities for charcoal burning and vacuum boiling are such, that were it not for the pressure of fiscal restrictions, there can be no reason why they should not turn out their staple as white or refined sugar at once. * * *

Gradually home refiners and colonial sugar-growers seem to be arriving at one common term of belief, namely, that if a sugar is to be refined at all, then exposing it to two crystallizations—one in the colonies and one at home in the refinery—is not only energy needlessly expended, but sugar thrown away. Accordingly, on certain estates, the juice is boiled down at once to a concrete form without any attempt at crystallization, and in this state brought to the home refinery.

The Icery Process.—The following rather amusing paragraph is from a Mauritius newspaper:—

From news which we have received from London we learn that the refiners and brokers of Mincing Lane have coalesced to endeavour to hinder a progress which cannot fail to reduce their occupation to *nil*. If the Icery process was costly they would have some chance of success, but the contrary is the fact. The sugar made by the monosulphite of lime process brings a better price because for an insignificant expense we obtain a notable increase in the return from the cane as shown by greater facility of crystallization and the saccharine poorness of the molasses of which the distillers complain. Whatever the speculators of London may be able to do we shall continue to send them sugar made by the monosulphite process. It is only necessary to find the means of satisfying the wants of the Metropolitan grocers. We have under our eyes letters which inform us that in London the Icery sugar is found fault with as being too dry, too white, and too hard grained. It will be easy to remedy these faults by sprinkling the sugar with a little molasses before packing it. This operation would certainly render it softer, moister, and yellower, and consequently better adapted to the wants of a certain class of consumers!

THE COLONIAL COMPANY (LIMITED).

The fifth ordinary general meeting of shareholders was held on Thursday last, at the offices of the Company, 16, Leadenhall-street; the chair was occupied by the Right Hon. E. P. Bouverie, M.P.

The notice convening the meeting was read by Mr. T. H. Glennie, the secretary; and the following report of the directors was taken as read:—

"The following is the result of the company's operations for the past year:—The gross profits have amounted to £95,742 0s. 7d.; deduct the charge for business expenses and interest on debentures, £34,785 14s. 7d.; there remains a nett profit of £60,956 6s. 0d.; add balance of profit and loss brought forward from last year, £12,749 10s. 11d.; together, £73,705 16s. 11d. From this has to be deducted interest due to vendors on amount credited in advance on the 10,000 shares allotted to them under contract, at 5 per cent., £1,250; *ad interim* dividend of 10s. per share, declared in July, 1869, £14,759 10s.; *ad interim* dividend of 10s. per share, declared in January, 1870, £14,759 10s.—£30,769; leaving a balance of £42,936 16s. 11d. The directors recommend that a further dividend of 12s. per share be now declared, which will amount to £17,711 8s. The total dividend thus declared, being 32s. per share, is at the rate of 8 per cent. per annum. The directors propose that the dividend for the year shall be free of income tax. An addition of £15,000 has been made to the reserve fund, making the total reserve £90,000. The balance of undivided profits to be carried forward to 1870 will be £10,225 8s. 11d. The directors in their last two reports alluded to the injurious effects of protracted drought in the West Indies, and to the probable injury the company was thereby likely to sustain. They regret to state that these effects have been more lasting and more injurious than they anticipated, and there was in consequence a serious reduction of the entire production of British Guiana and Barbadoes last year, which not only diminished the returns on the company's estates in those colonies, but also affected the profits on the company's ships. These drawbacks were to a certain extent com-

pensated by the enhanced prices which ruled for sugar during the year, and it is gratifying to the directors to be able to state that the company's estates are now recovering from the effects of the drought, and have improved in condition and prospects. The general commission business of the company continues to be quite satisfactory. The directors beg to announce that original debentures to the amount of £75,000 fall due on 31st December next, and that they are now prepared to issue others to a similar amount, having not less than five years to run, to replace them. In accordance with the articles of association, two members of the board retire at this meeting. The retiring directors are the Right Hon. E. P. Bouverie, M.P., and John Balfour, Esq., who, being eligible, offer themselves for re-election. Warrants for the additional dividend of 12s. per share will be issued on the 5th July next."

NOTICES OF BOOKS.

The Sugar-Beet and Beet-Sugar. By J. H. Porter, Assoc. Inst. C.E.

THE object of this ably written pamphlet appears to be to promote the cultivation of the beet root and the manufacture of beet sugar in the United Kingdom; to give the author's own words from the introduction "impressed with the magnitude of the benefits attending the cultivation of this important industry, he ventures to offer this contribution of facts and figures, old and new, in aid of the more valuable efforts of its abler advocates."

After referring to the efforts to manufacture sugar from the beet at Mount Mellick, Ireland, and stating that the failure of these efforts was not the result of any natural disadvantages, the author turns to the continent and shows the vast strides which this industry has taken during the last eighteen years, and then endeavours to prove that there is no reason either in soil climate or amount of available cheap labour why the beet sugar industry should not be equally successful in this country, and that there are reasons why it should prove to be even more profitable.

The experiment of Mr. James Duncan, at Lavenham, is brought forward, but as this gentleman does not produce sugar at his

factory, but only syrup, which is sent to his refinery in London to be crystallized, his example is not one to furnish complete data as to whether the manufacture is profitable or not. From statistics which the writer furnishes of the expense of growing beet, and the price at which the sugar manufacturer is able to give for it, there seems to be no doubt that the *growth* would be of a profitable character, although the allowance of £1 12s. for rent, tithes, and taxes of an acre of land, of which the soil "should be of the best quality and under the best conditions," appears to be somewhat low, especially as the rent of beet growing land in Belgium is stated to be from 40s. to 55s. per acre.

The present very depressed state of the sugar market and the large stocks existing does not appear to be the most encouraging time to commence adding to the production, but it is the author's opinion that there is room for a much greater development of the sugar cultivation generally, and that England and Ireland ought to share in such a very profitable manufacture. Whether we agree with him or not in the great advantages to be derived from it (which can only be proved by long continued trial), we must acknowledge that he has stated his case remarkably well, and fully triumphed over the difficulty he mentions of condensing his facts and the reflections arising from them. He concludes his arguments by the following paragraphs:—

"The last stronghold of slavery whence the civilized world has hitherto been supplied with more than one-fourth of its consumption of sugar is in the throes of a revolution, and slavery will fall. Cuba which hitherto has produced 600,000 to 700,000 tons of sugar cannot but suffer a diminution in her harvest when she has free labour only to rely upon. None can labour in those fields with the same effect as the African race, and the African as our West Indian properties testify, is by no means disposed to labour more than positive necessity demands. Under a tropical sun his wants are few. Industrious, painstaking, and intelligent as are the Chinese, their aptitude in skilled labour leads them to occupations of a higher class than the labours of the cotton and cane

fields, so far at least as to preclude our regarding them as a substitute for the negro."

"Much possibly may be done by the discoveries of science, and by new inventions in machinery or by superior organization of what already exists of both, to extract from the cane a larger proportion of its sugar than is now obtained but not to an extent to check the onward progress—*in climates more favourable for the treatment of saccharine plants*—of the great industry it is the object of these pages to promote."

THE COMING CROPS.

ACCOUNTS from the beet root districts of France represent the crops as having suffered very severely by the continued drought. It is true that the authorities differ as to the mischief done, whilst the *Journal des Fabricants* looks upon it as very serious, *La Sucrerie Indigene* takes a more hopeful view of matters, but private information which we have received leads us to believe that in some districts, at least, the beet root has suffered much more than the most favourable weather in the future will enable it to overcome. In Germany, where the sowing of the beet was rather later than usual, the cold winds and the drought have not been favourable to its development, but as yet there does not appear to be much cause for apprehension.

From the different parts of Louisiana there have been generally good reports of the coming crops, but latterly complaints are made of the long continued drought. More land is under cane culture than last season, some accounts say one-fourth more, and the crop is estimated at from 150,000 to 200,000 tons.

The accounts from Mauritius have been much brighter; plentiful rains had fallen, but the next season is not expected to be quite as prolific as last.

From Reunion the accounts are not nearly so favourable, as although rains had fallen in some parts, yet the drought continued to prevail in others, and the next crop is, it is said, sure to be much smaller than last.

Correspondence.

To the Editor of the Sugar Cane.

Sir,

I note in your publication of June 1st a paragraph extracted from *The West Indian*, headed "Emigration to Jamaica," in which "An Old Planter" condemns what he says "the Jamaica newspapers" are "strongly advocating," viz., "white immigration." Now "white immigration" is a general term and "The Old Planter" is content to condemn "white immigration" generally. He who can do this is either unqualified to give an opinion or has the interest of the island even less at heart than those who a short time since abolished slavery without primarily instituting and subsequently maintaining a system of compulsory labour for the negro.

"The Old Planter" wishes his communication to be inserted in order "to warn and put on their guard the poor labourers of England." Had he pointed out those who, with regard to their own interests should immigrate and those who should not, which from a twelve years' residence one would think he might easily have done, he would have rendered your readers some service. The Jamaica newspapers have surely, for once in a way, seen their own interest and that of others in a true light. Does a "white immigrant" mean only one who can hold a hoe, dig a trench, or guide a plough? Such indeed "could not undergo the toils of a labourer in that severe climate." No, a white immigrant may be a carpenter, or a wheelwright—a man who can drive a plough, an engine driver; What a treasure! an engineer or book-keeper. For the industrious artisan there is employment, and almost on his own terms. It is a respectable middle class artizan that is required (but by no means a field labourer). For all such there is a welcome in Jamaica, and indeed a daily cry.

A THREE YEARS' RESIDENT.

TO THE EDITOR OF THE SUGAR CANE.

SIR,

I am compelled to postpone for a few weeks my papers upon cane manure; but, I trust to be able soon to bring forward some more facts bearing upon this important subject, and shall have pleasure in communicating them to the readers of the "*Sugar Cane.*"

I am, Sir,

Your obedient Servant,

T. L. PHIPSON, PH.D., F.C.S.

London, 20*th June*, 1870.

FRENCH PATENT.—FROM LA SUCRERIE INDIGENE.

M. DOMINIQUE, à Plagny Nièvre. *Process relative to the defecation and the decoloration of saccharine juices and syrups of the beet root and the sugar cane, by the use of the neutral salt phosphate of alumina.*

As will be seen by the title of the above patent, the process is based on the use of the neutral salt phosphate of alumina. The operation is conducted as follows :—

The juice is defecated by lime or by any other alkali as usual, it is allowed to settle and the clear liquid decanted. Into this is added little by little, phosphate of alumina in a liquid state, as long as a white flakey precipitate continues to be formed, or until the red test paper indicates that the liquid is neutral or feebly alkaline; it is then carried to the boiling point for a few minutes to gather the precipitate. This precipitate is no other than tribasic phosphate of lime and hydrate of alumina, in a gelatinous state; it has united with it all the albuminous principles and colouring matters, it has acted in the same way as albumen in the clarification. The whole is passed into a Taylor's filter and the liquid which runs out may be at once evaporated and crystallized without filtration through animal charcoal.

The precipitate may be either mixed with the skimmings of the defecator and pressed with it, or treated by itself. Of the residue a very powerful nitrogenous and phosphated manure may be formed, or the phosphate of alumina may be recovered from the precipitate by treating it with a sufficient proportion of sulphuric acid.

The process is applicable in the same manner to molasses, and to all kinds of syrups.

According to the patentee the process possesses the following advantages :—

1st.—Abolition of the use of animal charcoal and of carbonic acid, and of all the labour which they entail.

2nd.—Return of sugar, superior both in quantity and in quality.

3rd.—Formation from the residues of a powerful manure, which instead of being of *bicarbonate* of lime is of phosphate of lime mixed with nitrogenous substances.

4th.—Possibility of producing with these residues an artificial guano by simply adding magnesia.

As a general remark on this patent it may be said that the use of phosphoric acid introduced under different forms into the juice in the place of carbonic acid with the object of eliminating the lime, has often incited the researches of inventors since Kuhlman and it will doubtless continue to do so.

Practical experiments have in fact demonstrated the harmlessness of the alkaline phosphates as regards the colour, the taste, and the crystallization of sugars. However, phosphoric acid has until now presented these inconveniences; that it is too costly, and that in consequence of the large quantity required to be added to the juice it produces a bulky precipitate difficult to work, with respect to the nature and the quantity of sugar retained in it.

Further, to bring the free alkalies to a state of phosphate, it is necessary to commence by removing from the juice the whole of the lime; but it is indispensable for the ulterior treatment that the juice should retain a small quantity of this base, to prevent its undergoing further modification. This is the one difficulty which up to the present has not been surmounted and it has been remarked that the low products of juices treated by phosphoric acid have always a tendency to ferment.

Walkhoff, however, has expressed the following very favourable opinion respecting the phosphate of alumina, although employed in other conditions than those mentioned in the patent.

"We shall certainly find," he says, "the means of rendering possible the use of phosphoric acid, it may be, for instance, in eliminating at first from the juice the organic matters, or similar substances, it may be in the discovery of another agent than lime to insure the preservation of the juice. This point once acquired, we may guarantee the greatest success to the use of phosphate of alumina, added after the saturation of the lime by carbonic acid."

EXPORTS FROM HAVANA AND MATANZAS, FROM JANUARY 1ST TO MAY 14TH, IN THOUSANDS OF TONS.

	1870.	1869.	1868.
United States of America	92	115	86
Great Britain	83	61	73
North Europe	7	6	9
France	19	20	18
Spain	30	22	24
South Europe	1	1	3
Other parts	3	3	4
	236	228	217
Stock in Havana and Matanzas	155	96	126

SHIPMENTS OF SUGAR FROM THE MAURITIUS FROM 1ST AUGUST TO THE 3RD OF MAY, FOR THE LAST THREE SEASONS.

	Crop 1869-70	Crop 1868-69	Crop 1867-68
	Tons.	Tons.	Tons.
United Kingdom	36,233	20,475	45,350
France	11,155	5,179	1,655
New Zealand	3,321	2,564	—
Australia	40,527	29,246	28,122
Cape of Good Hope	1,457	732	1,483
Bombay	28,783	13,268	24,956
Other ports	1,129	676	520
	122,605	72,140	102,086

Latest Statistics of the European Beet-Root Sugar Crop, for 1869-70, Compared with the previous season, in thousands of tons.

	1869-70.	1868-69.
Zollverein	215	208
France	285	214
Austria	113	76
Russia	100	65
Belgium	45	37
Poland and Sweden	32	22
Holland	12	10
	802	632

Consumption of Sugar in Europe and in the United States, in thousands of tons, for the years ending April 30th.

	1870.	1869.
Europe	1282	1208
United States	431	418
	1713	1626

Stocks of Raw Sugar in the Chief Markets of the World, in thousands of tons, to April 30th.

	1870.	1869.
United Kingdom	128	99
France	87	86
Holland	40	40
Zollverein	16	23
United States	127	83
Cuba to 14th May	155	96
Total	553	427

SUGAR STATISTICS—GREAT BRITAIN.

To 18th June, 1870 and 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	29	5	2	12	48	30	44	7	5	21	76	76	24	3	3	9	39	79
British East India	12	1	..	..	13	8	4	..	..	..	5	8	7	2	..	..	9	9
Mauritius	6	2	..	1	9	5	11	2	7	5	25	15	7	..	9	4	21	18
Cuba	7	5	4	15	31	19	6	11	15	40	73	42	9	9	11	31	61	42
Porto Rico, &c. ..	4	8	..	2	13	3	4	14	..	2	20	5	3	7	..	1	11	7
Manilla & Java ..	32	9	..	1	42	47	9	8	2	2	21	27	13	6	2	3	24	21
Brazil	..	18	1	5	24	14	1	30	3	12	46	36	..	20	3	9	33	43
Beetroot, &c.	3	1	..	1	5	2	15	6	3	14	37	23	14	7	3	17	40	24
Total, 1870 ..	91	48	8	37	185	128	93	79	35	95	302	232	78	55	33	73	239	242
Total, 1869 ..	79	26	7	15	Increase 57		92	41	31	68	Increase 70		86	52	28	77	Decrease 3	

STATE AND PROSPECTS OF THE SUGAR MARKET.

The market for sugars of all descriptions has been very quiet during the past month, good qualities, which had generally maintained their position, have during the last few days submitted to a slight decline. The advance obtained on low sorts at the end of the previous month has not been maintained, and there is so little demand for them that a further decline has been submitted to in order to effect sales. There has been a decline of 1s. in loaf sugar, and from 2s. to 3s. on crushed and pieces. Common refined lump sugar is quoted at 39s. 6d. to 40s. in London; good refining qualities of West India are selling about 26s. duty paid.

The accounts of the serious injury sustained by the beet crop have had no effect on the market, as the root has often disappointed previsions of failure which have appeared to be well founded.

One of the most singular features in the market at present is, that sugars which at a former period of great depression were of nearly similar value, now present considerable variations in price, as is shown in the following extract from Messrs. Macgregor, Mildred and Co.'s *Weekly Sugar Report*, of the 18th June:

"It is a remarkable phenomenon, that whereas No. 12 Havana afloat, during the panic in May and June, 1866 was depressed to 21s. 6d. and a good refining quality of muscovadoes to 19s., whilst Bahia and Pernambuco cargoes commanded 19s. to 19s. 6d., and clayed Manilla without duty 18s. to 18s. 6d.; the latter descriptions should in the face of a reduction of 50 per cent. in the duty be depressed to almost as low a point, whilst No. 12 Havana afloat sells readily at 27s. to 27s. 3d., and a good refining quality of Cuba muscovadoes at 23s. 9d. to 24s. per cwt."

Whilst the large stocks in the chief marts continue to increase any material improvement in prices cannot be looked for. When deliveries which are now increasing have in some degree restored the balance, no doubt a more healthy tone will prevail.

THE
SUGAR CANE.

REGISTERED FOR TRANSMISSION ABROAD.

No. 13. AUGUST 1, 1870. Vol. II.

☞ The writers alone are responsible for their statements.

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ON THE VARIOUS QUALITIES OF SUGAR PRODUCED IN CUBA AND THE DIFFERENT MODES OF MANUFACTURE.

By Edward Beanes, F.C.S., Assoc. Inst. C.E., M.R.I.

(Continued from page 369.*)*

Ordinary Muscovado made with the Common Battery.

I said at page 368 that up to the time of baling the dense syrup from the copper, whether the sugar was intended for clayed or muscovado, the process was the same with the sugar-point for clayed being higher than that for muscovado. Having finished with the clayed sugars made in the common battery, the next in order is that of common muscovado.

The dense syrup from the last copper (about 41° Baumè) is baled into wooden or iron coolers, these are oblong shallow vessels, usually twelve feet long, six feet wide, and one foot deep. The syrup is then moved about occasionally with the view of equalising the granulation; it is not beaten up as is done with that intended for clayed sugar.

After the cooler is filled with successive strikes of syrup, it is again stirred and left to granulate; it becomes hard as soon as it is cold; it is then dug out with shovels and placed in hogsheads having holes in the bottoms loosely stopped with sugar canes. As the filtering goes on the cane plugs are occasionally moved about

so as to leave sufficient space for the drainage of the molasses; as the drainage proceeds the sugar sinks down and the hogsheads are filled up after the principal drainage has ceased; they are then headed up and sent to market.

The Common Battery in conjunction with the Vacuum Pan.

The treatment of the juice when the vacuum pan is used with the battery is the same in every respect as that already described until the syrup arrives at the last copper, where, instead of being concentrated to sugar point, it is only brought to the density of from 25° to 27° Baumè and is then conveyed to the vacuum pan in which the concentration to sugar point is completed.

If the product is intended for clayed sugar, instead of being run into a cooler and beaten up as previously explained, it is run into a double bottomed steam vessel called a heater and is kept at a temperature of about 170° Faht. and moved about so as to finish the granulation and at the same time prevent the heavier crystals falling to the bottom; the rest of the operation is the same as that already described.

If the sugar is intended for muscovado it is run from the vacuum pan direct to the coolers previously mentioned but is not stirred up nearly so much as that which is concentrated to sugar point in the common battery.

Steam Defecators in conjunction with Animal Charcoal Filters, Vacuum Pans, and Centrifugals.

The steam defecators are cylindrical vessels with hemispherical double bottoms; they are usually made of copper and hold about 320 gallons each. These are placed in a range on a higher level than the tops of the animal charcoal filters. The whole range is connected by means of branch pipes and valves to a main steam pipe, the steam being admitted between the double bottom. They are also connected by means of check valves and branches to an exhaust steam main and this at its extremity to a steam trap. The latter is usually a cast iron vessel containing a float and cock inside; the water from the condensed steam causes the float to rise, opens the cock and allows the water to escape, but retains the steam.

Many planters have a separate steam trap to each defecator. In the defecator there is a scum pipe having slots near the bottom by which the earthy matters and the hard scum are retained while the juice flows out. The scum pipe is placed in the hole at the bottom of the defecator before being filled and removed after the juice has run out.

The cane juice as it comes from the mill, after passing through a copper sieve, is conveyed to the defecator either by a pump working in connection with the cane mill, or otherwise, by means of a "*mont-jus*." The defecator is filled to within three inches of the top, steam is let on and when the juice arrives at about 68°C milk of lime is added to neutralize the whole of the acidity. A dense dark coloured scum rises to the surface and when ebullition commences at the outer edge and a white scum breaks through, the steam is shut off; after a few minutes repose, steam is again gradually let on for a few minutes and then again shut off entirely. The defecation is now complete, but the juice is allowed to stand about fifteen minutes to let the portions of the scum floating in the juice rise to the surface and the earthy matters to settle to the bottom. The defecated juice is then run through animal charcoal filters which have already lost their decolorizing power for the syrup, but they only act as mechanical filters. These range in size from five feet diameter and eight feet high, to five feet six inches diameter and twenty-two feet high, but the former is the size more generally in use. The filtered juice is received into a tank from which it is pumped into the first vacuum pan. It is here boiled either by the exhaust steam of the cane engine while it is at work, or by direct steam when the cane crushing for the time has ceased. The steam arising from the cane juice in the first vacuum pan is used for boiling the syrup in the second pan, but the third vacuum pan, or strike pan as it is called, is boiled by direct steam from the steam boilers. A vacuum equal to a column of mercury four inches high is generally maintained in the first pan; from sixteen to eighteen inches in the second; and from twenty-five to twenty-six inches in the strike pan. From the first pan the juice is drawn into the

second according as it is wanted, it is here evaporated down to the density of 27° Baumè; a portion is then pumped out and elevated to a clarifier placed on a higher level than the top of the animal charcoal filters, another portion is then drawn from the first pan and according as the concentration proceeds the same operation is repeated.

The clarifier is a large cylindrical copper vessel with a coil of steam pipe near the bottom; the syrup is here brought gradually to near the boiling point and skimmed as long as any scum rises to the surface, but as there is a considerable quantity of scum floating in the body of the syrup in the clarifier the syrup is run into precipitating vessels, allowed to settle and the clear syrup run through animal charcoal filters. From the filters it is run into a tank, whence it is drawn into the strike pan as required and evaporated to sugar point. The rest of the operation is the same as that already described.

When the sugar is intended to be purged in centrifugals, it is in some cases allowed to finish its crystallization in the moulds. The sugar cones are afterwards cut up in a machine, mixed with their own molasses and passed through the centrifugal. In other cases it is allowed to crystallize in the shallow covers already described and when cold it is dug out with a shovel, mixed up with the molasses and put into the centrifugal. If the sugar is intended to be white it is watered by a syringe while the centrifugal is in motion, but in some cases white syrup is used instead of water. The molasses is reboiled in the strike pan to sugar point and run into coolers to crystallize. On some plantations this is repeated twice over, but the sugar obtained requires a much longer time to crystallize than that obtained direct from the cane juice, the grain is also much softer.

Having described the process of manufacturing sugar in the various kinds of apparatus in as concise a manner as I possibly could, I will in my next point out some of the defects of each and endeavour to show how they may be remedied.

(*To be Continued.*)

THE IMPHEE OR PLANTERS' FRIEND.

In *The Journal of the Agricultural Society of New South Wales* for May 15th is an account of the growth of the Imphee, (*Holous Saccharatus*) a plant allied to the sorghum but differing from it. It appears that it affords an astonishing amount of fodder for cattle; Sir William MacArthur having grown 35 tons to the acre, but of more consequence than this is the fact that although a colonial experimenter had been unable to make its saccharine juice into anything more than a syrup, yet sugar had been made by a Frenchman of Bourbon by a very simple process from this syrup, after it had been kept until active fermentation had commenced. The Journal quotes at length from a work on the Imphee or Planter's Friend, by Hy. S. Olcott, published in New York some years ago; we reproduce the extract as likely to be of interest to many of our readers. The plant can scarcely have proved so valuable as Mr. Olcott believed it to be, or it would by this time have come into more general cultivation. Perhaps some of our correspondents in the United States can inform us to what extent the Imphee is now being cultivated in Louisiana or any other of the States *as a sugar producing plant.*

CULTIVATION, INCLUDING SOILS, CLIMATE AND SEASONS.

Climate.—It may be safely stated as an indisputable fact, that wherever maize or Indian corn will grow and ripen its seed, Imphee will likewise grow and elaborate its juice so as to be suitable for sugar making, bearing in mind always that inasmuch as the maize comprises varieties which require five months, and others which require only three months, so in like manner does the Imphee include those varieties requiring four and a half months, and others again which ripen in two and a half and three months only.

This is a very essential fact to be remembered, in order to adapt in all cases the variety to the peculiar character of the locality; and I believe that no explanation, however lengthy, could more accurately define the climatic range of the Imphee than simply classing it with maize in this respect.

In Northern Europe, and in numerous other parts of the world, no kinds of maize can be profitably cultivated but those which ripen their seed within ninety days from planting; and it will be found that in all such localities no other varieties of Imphee can be successfully employed but such as ripen their juices within the same short period. But what truly enormous range does this climatic adaptation give us! It comprises, in fact, every country of the earth that can afford three months of hot summer weather. It does not even exclude Canada or Russia.

But as we draw nearer and nearer to the equator, the gradual lengthening of the summer season, until indeed winter is unknown, affords a longer and longer growing time, so that at last, instead of *one* crop, we can obtain two, three, ay, and even four crops in one year.

It is evident, likewise, that the longer the summer or warm weather extends, the greater scope exists for the cultivation of the larger and more productive varieties that require a longer time for their perfect development.

The small measure of temporary success which is said to have attended the attempts made in 1785, by Signor Arduino, of Florence, to introduce varieties of the *Holcus Saccharatus* into European cultivation, and their ultimate failure and consequent total disuse, arose from the simple circumstance of his having unfortunately lighted upon varieties which require too long a period for their perfect maturity to suit the short and variable summer of Europe.

I cannot impress this important point too strongly upon the attention of my readers, for on it, in fine, depends the success or failure of the whole cultivation for the purposes of sugar making. In tropical climates the planter is of course free to choose whichever variety his fancy or his experience in time to come may lead him to prefer; nor can any set rule be laid down which he must of necessity follow.

It is to be supposed that he will select those varieties which will not only yield him a large return per acre, but will afford him an extended period for his manufacturing operations, instead of all becoming ripe together.

Soil.—Imphee will grow well and produce sugar abundantly in a great variety of soils; and in this respect it is very similar to the real sugar-cane; but among the many advantages which it has over its great rival, the perfect immunity it enjoys from the attack of white ants is one much too important to pass over without remark.

In the colony of Natal, the white ant is as numerous, and fully as destructive, as it is in India; consequently, none but low-lying, swampy grounds can be used in that colony for sugar-cane cultivation; and this fact places a restriction upon its extensive culture in Natal, which no human art can overcome. But such an affliction does not extend to the Imphee. On the contrary, the white ants (although swarming in the soil) never touch these plants. I have grown a fine crop of Imphee on a sandy hill top, where it would have been utterly impossible to grow sugar-cane on account of the white ants.

This seems a small matter to dwell upon, but in reality it is of the utmost importance to Natal, India generally, the Straits (Malacca) settlements, and to every other country wherein that insect scourge exists; because it admits of sugar being produced from the Imphee on millions and millions of acres which are totally unsuited for the sugar-cane.

This simple fact alone is calculated to enhance the price of land in Natal and the Cape Colony to an immense extent, and it will have the same effect in many other countries.

I have introduced the subject of white ants in this place, because in the trial of soils suitable for the sugar-cane, it is absolutely necessary to exclude all those infested by white ants, whereas in the culture of the Imphee their presence is of no consequence.

In rich alluvial soils, in good light brick mould, in loamy soils, and, indeed, in almost every good soil in which there is a fair admixture of vegetable mould, the Imphee delights and will grow famously with sufficient moisture.

Plenty of vegetable mould, strong heat and light, and considerable moisture, form the great essentials to the full development of the plant and the perfect elaboration of its juice, so that it shall yield its maximum quantity of saccharine matter.

If, after a season of long continued showery weather, a period of dry weather occurs just as it ripens, then the juice is more especially abundant, and rich in sugar.

Soils highly manured with animal manure, or, in fact, with any which abound in ammonia and other saline substances, tend to the formation of a large, luxuriant plant, but its juice under such circumstances is so mucilaginous and saline as to render it extremely unsuitable for sugar manufacture, hence such treatment should be studiously avoided.

The same rule applies in the case of the sugar-cane, beet root, and other sugar-yielding plants; and if it be violated, the result is certain to be disappointment and vexation.

Mode of Culture.—I have, in some instances, soaked the seeds of the Imphee for twenty-four and even forty-eight hours, in warm water, previous to planting them, in order to expedite their germination, as seeds so treated will, in warm, moist weather, be up in four days afterwards; whereas, being planted (during showery weather) without this assistance, they usually take six or seven days for sprouting. If, after planting, dry weather sets in, they will, however, require ten or even fourteen days to appear above ground; but by being well soaked beforehand this casualty is materially obviated. Hence I hold the practice to be a prudent one.

The seeds require to be very lightly covered; for, if deeply set, they are liable to rot, should much rain occur immediately after; but lightly covered, they will not be injured by even constant rain.

I have lost a great deal of seed by planting too deeply, and I shall, therefore, be very cautious never to commit the same error again. If soaked in warm water for twenty-four hours, then planted in a bed, and care taken to keep them properly moist, we may always calculate with certainty on having them an inch above ground in four days (warm weather).

This first start is a great point wherever the warm weather lasts only a short time; but in no case is it altogether unimportant; and it becomes a question of no small moment, whether in England and some parts of Northern Europe it would not even be quite worth

while to sow the seed under glass in the first instance, and then plant out the young plants, before they are a month old, in the open ground, where it is intended they shall remain for crop.

In this case, very little more labour is required than is now universally bestowed on the Continent in making the beet root nursery beds, and subsequent transplanting of the young beets. My own experience this season, in England, has shown me that even in a small greenhouse a prodigious number of young plants may be raised without any artificial heat whatever, and the plants are so hardy that they bear transplanting admirably.

By this simple plan we get over the difficulties opposed to us in England by late frosts and cold, nipping winds, for we can commence transplanting in June, and thus allow June, July, August, and part of September, if needed, for their growth, which my experiments this season have clearly demonstrated to be quite sufficient. If it be objected that this plan entails more than ordinary trouble, I answer it also ensures the safety of a valuable crop, a consideration of no small importance.

It must be remembered that every seed will, under favourable circumstances, "tiller" out so largely as to have from ten to twenty stalks or canes (as I shall henceforth call them), forming a large stool, and occupying a considerable space.

I have found that rows three feet apart, with plants twelve inches from each other along the rows (being about 14,000 per acre), in most cases, was a very suitable distance to plant them; but the ever-varying circumstances of soil, climate, and seasons, added to the differences between the larger and the smaller varieties of the Imphee, must naturally suggest corresponding differences in the planting distances.

I have had the Nee-a-za-na in rows only two feet, and again in rows two and a half feet apart; but I will not venture to say that in all cases such close planting is proper.

In planting along the rows, wherever the plants are too thick, they can always be thinned out during their early growth.

The great objection to the adoption of close rows is the very serious one arising from the difficulty of cleaning and digging

between them, which is so desirable and so very conducive to their vigorous growth and perfect development; for, in common with almost all other plants, the Imphee likes to have the soil loosened and moved about around its roots.

I suppose that it is almost unnecessary to observe that, although it likes abundance of moisture in the soils whereon it is growing, yet it has a decided objection to stagnant water being around its roots. As the plant progresses towards maturity, it throws up its graceful flower, which very speedily is transformed into a seed head, most abundantly covered, or rather laden, with grain

In the last chapter I alluded to the Kaffir custom of removing these seed heads shortly after they appear, and I can only repeat the doubt I there expressed, whether, by so doing, we may not really lose more than we gain.

When allowed to perfect its seeds, the grain is generally plump and full of fine, white flour, which I believe is wholesome and nutritious, and might enter largely into general consumption.

This, in itself, constitutes a feature much in favour of allowing it to ripen its seed; and, in a more general sense, is highly important.

Notwithstanding my numerous unsuccessful attempts some years ago to impregnate or fecundate the flowers of the sugar-cane, so as to obtain a seed which would germinate and produce sugar-cane, yet I cannot help clinging to this plant (Imphee) as the only remaining hope we now have of effecting this interesting object. I have already taken measures to have new flowers of the sugar-cane brought into immediate and continued contact with those of the Imphee, so as to ascertain for a certainty whether the sugar-cane will thereby be induced to perfect its seeds, and, on the other hand, whether the pollen of the cane flowers will produce any beneficial or other change in the character of the imphee seed.

This is a question of sufficient interest to engage the attention of every scientific and inquiring mind, as it comprehends that which is interesting, and that which may be of great practical utility to the world at large.

When the seeds of the Imphee are ripe or perfectly full, it is the

custom of the Zulu-Kaffirs to string them up in the sun and air for a few days, then to hang them up in their huts, so that they may have the full benefit of the smoke, which serves to keep them entirely dry, and likewise preserves the seed from the attacks of insects, so that they may be thus kept perfectly good for a series of years, if necessary. I like this plan so much that I adopted it in all its integrity, and can honestly recommend it to others.*

THE PLANT: ITS PRODUCTION AND ITS VALUE.

It will seem, from what I have already said, that the canes of the Imphee are much smaller and much lighter than the stalks of the real sugar cane; but at the same time, it must be remembered that the foliage is not nearly so large nor so dense as that of the sugar-cane; consequently the plants can stand very much closer together on the land, and thus make up in number for their smaller weight individually.

Thus, on an acre, if we have only 14,000 roots or stools, each stool will produce from five to twenty canes, varying in weight from a quarter of a pound to one-and-a-half pounds each, affording on a low average, therefore, we will say, 84,000 canes, weighing 65,000 pounds, capable of yielding seventy-five per cent. of juice; but if taken at only seventy per cent. then giving 44,100 pounds of juice, containing fifteen per cent. of sugar.

If from this quantity of juice the manufacturer cannot manage to produce two tons of good, dry, fair-coloured sugar, then he must be unskilful indeed.

One English acre of Imphee, grown under favourable circumstances, will yield fully two tons of dry sugar, and even more; but I will not estimate the average return at more than one and a half tons of fair, dry sugar per acre, which it should most undoubtedly produce as an average crop.

For the information of those planters who are compelled to use their cane trash or megass, I may say that the trash of the Imphee

* It is worthy of remark that the natives of Upper Egypt call the sorghums *Baalee* or Doura; whereas, the Zulu-Kaffir name for the same plant is *Mabaalee*, the *ma* being simply a prefix which they give to a great number of their proper names.

can be used precisely in the same manner, although its proper use really is as a manure to return to the soil.

The leaves and long tops of the plants form excellent food for horned cattle, horses, mules, sheep, &c., being much more delicate than the coarse leaves of the sugar-cane.

If the plants are suffered to mature their seed, an acre of land would furnish a large quantity of grain, which may be used merely as grain for feeding animals and poultry, or in the form of flour, of excellent quality, as food for mankind.

I consider twenty bushels of this grain per acre a very low average crop, but it is by no means an item to be overlooked in calculating the value of the plant to Europe and the world generally.

Having shown the value of one crop of Imphee, perhaps it would be well to repeat that this one crop of Imphee is off the ground in from three to four months from the day the seed was planted; and that, as this comes off, another crop is immediately springing up from the same roots (if the weather will permit) to be ready in another three months; and even a third crop will be produced, provided the weather is warm enough.

We must now compare the Imphee with its European rival, the beet root, which is at present so largely grown for its sugar.

I find that there is now manufactured throughout the whole continent of Europe (on the soil devoted to it) something like eight hundredweight of good sugar per English acre.

Besides the sugar obtained from the beet root, we must take into consideration its other products, such as potash and alcohol, yielded by its molasses, and the quantity of food for cattle, furnished by its leaves and by its refuse pulp.

M. Dubrunfaut declares that by a certain process of his own there may be obtained from the molasses a quantity of potash equal in weight to one-sixth of the sugar produced from the beet root.

It is, however, quite evident that this quantity of potash can only exist in these roots by reason of the excess of saline matter in the soil whereon they are grown.

In the great majority of cases this injurious excess of saline substance arises from the quantity of manure administered to the soil, with a view of obtaining a very large and heavy crop of beets —a result certainly realised, but at a great sacrifice of saccharine matter in the beets.

Viewing all these products, however, in the most favourable light possible, still no reasonable being can maintain for one moment that the produce obtainable from one acre of the beet root is in any way equal to that derivable from an acre of Imphee, namely one and a half tons of fair sugar, and its proportionate quantity of molasses, equal in every respect to the cane sugar molasses.

The next point of comparison is the expense of cultivation and manufacture; and I am firmly convinced that these are entirely in favour of the Imphee, for, at the present moment, the practice is almost universal on the continent of sowing the seed, in the first instance, in a seed bed or nursery, from which they are afterwards drawn and planted out in the fields. I do not say that this common practice is imperative, nor do I object to it on the score of economy, or any other grounds, but I merely state that such is the usual custom. The period from sowing the seed to harvesting the beets, varies, according to my information, from seven to eight months, a space of time just double that required for the perfect maturity of the Imphee.

This prolonged period naturally requires a corresponding addition of labour in the cultivation over and above that demanded by the latter.

But in the manufacture of the two a still greater difference exists in favour of the Imphee. The beets have to undergo a careful washing, and have their crowns and roots cut off before they are fit for the manufacturer's operations; then they are either rasped by machinery into a complete pulp, which is afterwards put into a canvas cloth and subjected to the action of a hydraulic or other press, to get out all the juice; or they are cut into very thin slices, and these are treated by sundry peculiar processes, in order to obtain the sugar they contain in as pure a state as possible. The saccharine liquor, or expressed juice from the canvas bags, is next

chemically treated to effect its defecation, and is afterwards evaporated to a certain density, run through animal charcoal filters, and finally concentrated, but only to undergo a further refining, or perhaps double-refining, as the raw beet root sugar (such as we may call beet root muscovado) is unfit for general purposes, and therefore cannot be used for common consumption as sugar-cane muscovado sugars are.

There are certainly many other highly scientific modes of obtaining the sugar from beets, among which the elegant chemical process (at present only partially applied) of Dubrunfaut is deserving of all honour; but I confine my remarks especially to those best known and so generally used on the continent.

The manufacture of Imphee is on the other hand extremely simple; and the sugar produced, whether muscovado or white, is not distinguishable, even by the best judges, from the cane sugar of similar qualities; while the expense of manufacture is much less than that of beet root.

The main result of this comparison, apart from expenses for cultivation and manufacture, may then be stated:

Imphee.—Time of growth, three to four months; sugar, per acre, thirty cwts.; molasses equal to cane molasses.

Beet Root.—Time of growth, seven to eight months;* sugar, per acre, ten cwts.; molasses very inferior.

This, too, is on the broad supposition that the value of the molasses, fodder, &c., of the one, equals that of the other. I venture to say that the comparative value is so entirely in favour of the former, that beet root culture will gradually be relinquished until it becomes at length totally neglected.

We next turn to the sugar-cane as its great rival; and I dare say I shall be considered very bold in venturing a comparison, but facts are stubborn things, and no really sensible man will come to a decision until he has carefully weighed the evidence on both sides.

The sugar cane is a plant too well known to need any description here; but there are some peculiarities in regard to it which must be recited, although actual truisms:

* Mr. Olcott does not seem to have been aware that the beet is a biennial.

1. It takes, according to circumstances, from twelve to sixteen, to eighteen or to twenty months, from the crop being planted to its ripening.

2. Some very soft, juicy canes do really contain, chemically speaking, only about ten per cent. of woody fibre; but an overwhelming majority of sugar canes do most certainly contain practically a much greater proportion, some even as much as thirty per cent.!

3. Fine average cane juice contains eighteen per cent. of sugar, not more.

4. A good average crop of sugar canes will weigh from twenty-five to thirty tons per acre.

5. Canes are apt to degenerate so fast that constant recourse is had to the expedient of exchanging plant tops between estates very distant from each other.

6. The cane ratoons in twelve months, generally, from the time of cutting; and each time it rattoons the canes are less juicy, and contain a greater amount of woody fibre in proportion.

These points must be well considered:

1. During the eighteen months' growth what casualties may not occur to destroy, or, at least, very much injure, the crop: storms, severe drought, fire, and, lastly, white ants! And what sugar planter knows not the dire extent of these liabilities?

2. The large proportion of woody fibre contained in ratoons, and even in plant canes, naturally reduces very much the per centage of juice; but all ratoons do not so abound in woody fibre.

3. So alarming was the degeneracy of the sugar cane in Jamaica that its Royal Agricultural Society and the Society of Arts in London sought all over the world for sugar-cane seed, in the hopes of remedying this threatening evil.

Now, on the other hand, let us look at the Imphee in respect to those identical points.

1. It takes, as I have already said, from three months to four and a half months, according to the kind planted, from the time of sowing the seed until it arrives at maturity; and it will ratoon twice or three times afterwards, at intervals of three months

between each cutting, provided, of course, that the warm weather permits its continued ratooning.

2. It is much more juicy than the generality of sugar-canes, and contains far less of woody fibre, which does not materially increase in the ratoons.

3. Fine, average Imphee juice, contains fifteen per cent. of sugar.

4. A good average crop of Imphee stalks or canes will weigh twenty-five tons per acre.

5. Imphee is produced from the seed; therefore, no deterioration can occur, as in the sugar-cane; and the seed may be sown by means of a drill.

6. It will yield a crop of ratoons six to seven months from the time of the seed being first sown, being, therefore, two crops in that space of time; and will continue rattooning, if the seasons are favourable.

All these points I have abundantly proved to be correct; and when they are acknowledged by the world at large to be really true, what, may I ask, will become of the sugar-cane?

What tropical planter will eventually refuse to lessen his field risks arising from the casualties I have named, and simplify his cultivation, knowing at the same time that his crops come to bear a money value in the market in the short space of three to four months?

I venture to think that he will, of necessity, be compelled to adopt the Imphee and discard the sugar-cane, as a mere matter of self-preservation; for, although in Europe we can, perhaps, obtain only one crop from the land each year, yet the cheap modes of cultivation and the skilful manufacture which will be brought to bear upon it, will be quite sufficient to run the sugar planter off his legs.

From Canada to New Orleans, in America, we have a magnificent range for the growth of the Imphee; and in the southern states two crops a year will be obtained, in lieu of the one miserable crop of cane sugar now realized.

I think that even these extremely brief remarks will be sufficient, for the present, to show the comparative value of the Imphee, sugar-cane, and beet root for sugar making.

PRACTICAL OBSERVATIONS ON CANE MANURE.—No. V.

BY DR. T. L. PHIPSON, F.C.S., &c., LONDON,

Late of the University of Brussels, Member of the Chemical Society of Paris.

THE adulteration of manures has been carried on to such an extent within the last 15 or 20 years that it has been calculated, on an average, that for every £100 paid for manure £25 would have purchased the whole of the really valuable ingredients contained therein. Hence it soon becomes necessary to purchasers of those expensive fertilizers known as artificial manures, to have them duly tested and reported upon by the analytical chemist, and to fix their value by the results of the analysis.

This has become so thoroughly recognized of late years that many firms *guarantee* the composition of their manufactured product. Such, for instance, are the "Guaranteed Manure Co." of London as regards superphosphates, and Mr. Burt of Gainsboro' as regards shoddy, a nitrogenous substance known to be of very variable composition, though its price is exceedingly constant. This is a very creditable proceeding and should be adopted by all manufacturers and sellers of manurial products. Selling upon analysis is a step in the right direction, but a guarantee in due form is better still. When besides the price of a manure, its carriage to the distant sugar-cane soils is taken into consideration, it will be readily conceived how hurtful it is to export an adulterated product or one which is not likely to produce much effect upon the crops. Hence the advantage of the natural manure produced, as already stated, at Bloxwitch, which is suitable to all soils, and when mixed with lime salts, guano, or potash salts, as the case may be, will be found applicable with success to those that are well nigh exhausted.

In treating of the chemical composition of various manures, I shall have to deal with that of the Bloxwitch product, and to compare it and others with the wants of the cane soils of the West India Islands and British Guiana.

To day, I must first say a few words on silica, about which so much uncertainty appears to exist:—

The stalk of the sugar-cane takes up silica to an enormous extent. Burn a piece of cane, and the ash is found to yield, sometimes, as much as half its weight of silica. This is taken from the soil in the soluble form. It is supplied by all cane soils naturally, and to such an extent that its supply will last for centuries; and it will still be present in the soil, in an available condition, after all the other elements of fertility have been more or less completely exhausted. It is therefore quite useless to add this ingredient to a manure destined for the sugar-cane. The cane will not grow at all—any more than an *equisetum*—in a soil deprived of soluble silica; and all soils, wherein cane grows, are naturally supplied for thousands of years to come. The addition of soluble silica to manures (which has been sometimes done, at great cost, in form of silicate of potash), is, in effect, like adding a little salt to the briny waters of the ocean! At least it would be so, were it not that the potash of this expensive compound may have a good effect, and is so, as far as the *silica* is concerned. Sugar planters may thank Heaven that there is no need to supply silica.

The next ingredients we have to consider, are lime and potash. They are the most important, perhaps, of the whole series, for they are precisely those which appear to give in first in most cane soils. As far as my experience on this subject extends at present, it is usually the lime which first becomes deficient, dropping to 0·01 *per cent*, or even to a mere trace. There is a notable amount of lime in cane ash, as may be seen on referring to the analysis of it, published in various numbers of this magazine; but it is not certain that all the lime of cane ash is immediately available for the plant. In the Paris Exhibition of 1867, there were two samples of cane ash, called in the catalogue "Scorie de Megasse"; the one in a large lump, the other finely pulverised. The former had indeed a scoriaceous appearance, being fused like a piece of iron slag. The pulverised sample yielded a good deal of potash to cold water, and some sulphate of lime, &c., but the whole amount dissolved did not exceed 5 per cent. In order to fix the value of this substance as a manure, it would require to be more

frequently analysed than it has been, with this special object in view; for, its composition is very variable, and the raw product is always more or less largely mixed with sand and clay. In the meantime let it be used by all means, and let it be as finely pulverised as possible, before it is confided to the soil. Common chalk and marl, especially a porous marl containing 2 to 3 *per cent* of phosphates, will be found valuable in many long-worked cane soils.

Many cane soils are lamentably deficient in ammonia (or nitrogen), hence they profit wonderfully by application of some rich ammoniacal manure—such as Peruvian guano and sulphate of ammonia. But when other elements are somewhat deficient at the same time, the action of sulphate of ammonia only lasts a season or two, and then its effects begin to fall off rapidly. The cane requires nitrogen in the manure applied. It is all very well to say that plants derive their nitrogen from the air; so they do, indirectly, and a *wild* plant flourishes thereby. But a wild plant yields no crops; it yields a few flowers, assures the reproduction of its species, and there is an end of it. This is all nature requires, but man requires something more, and so he *cultivates* the wild plant.

Again, it is a poetical notion, and one upheld by modern science, that the sugar of the cane is derived from the air, not from the soil, hence, that by taking the sugar only, and restoring the megass, or at least the ash of the latter, to the soil, we rob the earth of nothing. Vain delusive argument! What has become of the *nitrogen*, so essential to the growth of all graminaceous plants? It has gone up the flue of the fireplace where the megass is burnt, forming 77 to 81 per cent. of the products of this combustion! It will doubtless return to the soil in time, *i.e.*, when this and the next generation are dead and gone, and *that* particular soil, whence it was extracted, has become exhausted and barren! As a rule good Peruvian guano should be preferred to sulphate of ammonia as a source of nitrogen.

Shoddy is another manurial substance rich in nitrogen, and cheap also, when its composition is guaranteed, as stated above, and not below 8 or 9 per cent. But it is very bulky, and supplies scarcely

anything but nitrogen, therefore it is best to work it into some more portable and more complicated manure. This can be perfectly well done without the use of acid, or superheated steam, both of which are faulty methods. Hot acid deprives shoddy of nitrogen as a mutton chop yields nitrogen, when heated with sulphuric acid.

It is easy to look upon sugar as derived from carbonic acid and water, so that its origin may, indeed, be traced (by theorists) to the moisture and carbonic acid of the atmosphere. So can we trace everything on this earth to the sun*, with the aid of Professors Guillemin and Tyndall, but we cannot modify the sun's nature to the benefit of the earth, neither can we make sugar from carbonic acid and water—at least, not in the sugar-cane—though, as nothing seems to be impossible to the chemist of the nineteenth century, the transmutation of a bottle of soda-water into sugar syrup would by no means surprise us.

The Cedars, Putney, S.W.
21st July, 1870.

MORTALITY AMONGST CATTLE IN EGYPT.

It seems that the Khedive will find considerable difficulty in preparing a further extent of land this season for sugar cultivation, for which purpose he is about contracting a considerable loan in France and England, and in connection with which he has ordered machinery of a costly character in England.

At present the land is ploughed by cattle, and there is just now a great mortality amongst the cattle used by the Daira for this purpose, and there does not seem much probability of the steam plough being introduced into Egypt during the present season at least.

* See Prof. Guillemin's curious little work, "The Sun," (London: Bentley, 1870,) in which everything we are and do "here below" is directly traced to the sun's influence.

ON THE ABSORPTIVE POWER OF SOIL.

BY ROBERT WARINGTON, F.C.S.

(From the Chemical News.)

HAVING described the results obtained in the College Laboratory, we will now attempt to point out those conclusions with regard to the phenomena of soil absorption which the accumulated facts of the case seem to warrant.

The question which chiefly demands attention is the nature of soil absorption. Is it a physical or chemical action, and by what ingredients of the soil is it exerted? In order to form a definite notion concerning the first part of this question, let us, in the first place, inquire, What is physical attraction? We will take the decolorizing power of charcoal as an example of this action.

Liebig tells us, and we believe rightly, that the attraction of the charcoal for the particles of colour is quite similar to the attraction by which these particles were previously dissolved and held in solution by water. "If the attraction of the charcoal is somewhat greater than that of the water, then the colouring matter is completely withdrawn from the water; if the attraction of both is equal, a division takes place, and the extraction is only partial."* Liebig, however, characterises this power of charcoal as *chemical*:— "This power in charcoal depends upon a chemical attraction proceeding from its surface."† Other chemists affirm, on the contrary, that the attraction of both charcoal and water is simply a case of physical adhesion; the same action by which a stick dipped in water comes out wetted. Against the chemical hypothesis it may be urged with force, that, to use Liebig's own words, "the materials attracted by the charcoal retain all their chemical properties;" so that on this view we really have chemical action taking place without any chemical change resulting. In support of the second hypothesis it may be observed, that charcoal appears to attract

* "The Natural Laws of Husbandry," p. 66.

† *Ibid*, p. 65.

chiefly those substances which are sparingly soluble in water; those, in fact, for which water has a small adhesive power, that may with comparative ease be overcome. *

Assuming, then, as most probable, that the action of charcoal and other similar absorbents is owing to the physical attraction of adhesion, we have next to ask, is this physical attraction exerted by soil, and can the absorptive properties of soil be thus explained?

It seems very probable that physical attraction is exercised by soil, and that the clarifying action of clay, and of soils generally, when brought into contact with sewage and similar solutions, is mainly owing to an absorbent action very similar to that exerted by charcoal under the same circumstances. But this physical action of soil we believe to have little or nothing to do with the absorption of ammonia, potash, phosphoric acid, and generally of those salts which form an important part of plant food. Charcoal appears to be quite incapable of removing ammonia from solution, and it seems, indeed, unlikely that so soluble a substance should be removed from solution by the force of adhesion of any solid body. The same may be said of many other soluble salts readily taken up by soil, but unaffected by charcoal. The probability of the action of soil in these cases being due to physical attraction is therefore very small. On the other hand, we have considerable evidence of chemical action in the absorption of many substances by soil; the evidence is, perhaps, strongest in the case of phosphoric acid.

It is now allowed by most agricultural chemists that the hydrated feric oxide and alumina of soil unite with the phosphoric acid applied in manure, and form basic phosphates of iron and aluminum. We have already described some experiments which appear satisfactorily to establish this reaction between soil and phosphoric acid. E. Peters has also recently published a research upon the same subject.† He endeavoured to ascertain the state in which phosphoric acid was held in soil, by acting on a soil, recently manured with bone dust, with different solvents. He came to the

* For some excellent observations on the subject, see Miller's "Chemistry," vol. i., pp. 73—75.

† *Annalen der Landwirthschaft*, 1867, p. 31.

conclusion, "that the phosphoric acid in soils is almost entirely combined with ferric oxide and alumina;" and, "that from a solution of phosphate of calcium in carbonic acid, phosphoric acid is taken up by soils only when the latter contain compounds of alumina or ferric oxide; soils deprived of these compounds by treatment with acids are indifferent to the phosphatic solution." His conclusions thus perfectly agree with those stated above; the absorption of phosphoric acid by soil is considered to be a purely chemical operation.*

If we turn to the phenomena which attend the absorption of bases from their salts, we also find considerable evidence of chemical action. The facts we refer to have been already noticed. We have seen that soil acts differently towards various salts of the same base; that the bases of phosphates and carbonates are taken up by soil in greater quantity than the bases of sulphates, chlorides, or nitrates. This preference is certainly due to the chemical relations of the various acids to the constituents of soil. The reaction between a soil and an alkaline phosphate will, after the previous discussion, be quite plain to us; the acid of the salt will be appropriated by the ferric oxide or alumina, and the base be thus left in the form of hydrate, the form most favourable to combination. Carbonates are known to all chemists as salts that are easily decomposed, even by bodies of feeble acid properties; the ready sbsorption of bases from their carbonates might therefore naturally be expected. The carbonic acid liberated probably combines, in most cases, with the lime of the soil. In one of Way's experiments, in which a solution of carbonate of ammonium had been poured upon soil, bicarbonate of calcium was found in the water which drained through. Sulphates, chlorides, and nitrates are not taken up by soil to any appreciable extent unless the soil already contains lime, magnesia, or soda; or, to speak more accurately, some base for which the absorbing ingredients have a smaller affinity than they have for the base of the salt presented to them. In the majority

* When a solution of superphosphate is applied to soil, the phosphoric acid is probably in the first instance precipitated by the lime of the soil; the action of the ferric oxide is in this case subsequent and gradual.

of cases lime is the active base in these reactions, and the acids of the salts are found combined with lime in the drainage water from the soil. Way showed in the case of a chloride, and Voelcker in the case of a chloride and nitrate, that none of the acid of the salt was absorbed by the soil. The salts had been decomposed by the lime of the soil, and their bases only had been removed from solution.*

Facts, in short, show very clearly, that when the solution of a salt is brought in contact with soil, the salt is always decomposed if absorption takes place; this decomposition is, of course, clear evidence of chemical action. We have been able to give a tolerably satisfactory account of all these reactions as far as the acids of these salts are concerned. We are not able to account so certainly for the bases; they are absorbed by the soil: but with which of the ingredients of the soil do they combine? We cannot trace their course in the reaction, and are obliged to resort to secondary evidence.

We have already mentioned two classes of bodies which experiment has shown capable of removing bases from the solutions of their salts; these are the hydrated double silicates, and the hydrated oxides of iron and aluminum. Now, if these compounds can be proved to exist in soil we are certainly warranted in concluding that the absorption of bases by soil is due to a greater or less extent to their influence.

There is no doubt whatever as to the occurrence of hydrated ferric oxide in soils; it is probably a universal ingredient of soil, and is often present in very considerable amount. The occurrence of hydrated alumina in soils is doubted by some chemists; it is, in

* We should expect from the results obtained when sulphate of ammonium was placed in contact with hydrated alumina and ferric oxide, that under some circumstances sulphuric acid would be retained in the soil to an appreciable extent. Curiously enough, this fact was noticed by Mr. H. S. Thomson in his original experiments of 1845. I have found no reference to it since. He observed that a solution of sulphate of ammonium became *alkaline* on being filtered through soil. The reaction would probably be observed in the case of soils rich in the hydrated oxides, but poor in lime.

fact, difficult to tell to what extent the alumina found in soil is combined with silica, and to what extent it exists merely as hydrate. The question does not, however, materially affect our argument, as we have seen that ferric oxide is apparently a far more efficient absorbent of bases than alumina. We may consider it, therefore, as established, that the ferric oxide present in soils plays a part in the absorbent action of soil towards bases, and that the bases absorbed by soil become, in part at least, united to ferric oxide.

It is very difficult to prove the presence in soils of the particular class of double silicates which Way has shown to possess such a remarkable power of removing potash, ammonia, and other bases from solution.* That soils contain both silicates, and hydrated silicates, does not admit of doubt; in fact, silicates are often the largest constituents of soil; but that the hydrated silicates are silicates of alumium and calcium, is more than chemical analysis has yet been able to decide. The probability that such silicates are present, is, however, very great. The felspars and micas, from the disintegration of which the silicates of soil are chiefly formed, are all of them double silicates of alumium with potassium or some other alkaline or alkaline-earthy base; that in the decomposition of these hydrated double silicates of a similar constitution should be formed, is certainly to be expected. There appears, in fact, no ground for reasonable doubt that the silicates described by Way are really present in soils, and we must, consequently, ascribe to these silicates a part in the absorbent action of soil.

There yet remains another ingredient of soil which, probably, takes some part in the absorption of bases,—this is the humus. Humus, or rather the various bodies which compose it, possesses a feeble acid character, and being insoluble in water, or nearly so, is very probably capable of forming insoluble compounds with bases.

* Eichhorn has examined the properties of chabazite, a native hydrated silicate of aluminium and calcium; he found that, placed in contact with a solution of chloride of ammonium, it absorbed a large quantity of ammonia and parted with lime, and in other respects comported itself like Way's artificially prepared silicate.

Brustlein * has experimented with pure humus obtained from a decaying oak. He found it to possess a considerable power of absorbing free ammonia, but with solutions of the salts of ammonium it failed to effect any absorption. Since soils and clays almost destitute of organic matter often possess high absorbent powers, the part taken by humus is probably of inferior importance.

We have, then, evidence that soil contains several ingredients that have the property of forming more or less insoluble compounds with bases, and are known to be capable of withdrawing bases from solution. Though, therefore, we are unable to trace the mode of combination of the bases absorbed by soil, we conclude, upon the evidence thus before us, that they are combined either with hydrated metallic oxides, with hydrated double silicates, or possibly with humus.

Our conclusions respecting the cause and manner of soil absorption may be summarised as follows:—

1. It appears that the hydrated ferric oxide and alumina of soil have a notable power of absorbing phosphoric acid from the solutions of its salts, and, to a much smaller extent, a capacity for taking up sulphuric, hydrochloric, and nitric acids (at least if these acids are presented in the form of ammonium salts); and that in all these cases the product of the absorption is a highly basic compound of the acid with the metallic oxide. It appears, further, that these metallic hydrates are also capable of absorbing bases, with which they either combine directly, or form highly basic double salts with acids either previously or at the same time absorbed. The hydrates are, however, incapable when alone of affecting any considerable absorption from a chloride or nitrate, although in the soil they probably absorb bases from these salts without difficulty, owing to the decomposing action of the lime of soils.

2. The hydrated double silicates contained in soil also exercise a very considerable absorptive power, which is confined to bases. The hydrated silicate of aluminum and calcium is capable of absorbing potash or ammonia from all the salts of these bases, and

* *Jahresbericht der Agrikultur-Chemie*, 1859-60, p. 1.

probably with nearly equal energy from each. The product in each case is a new hydrated double silicate, in which the calcium is more or less perfectly replaced by potassium or ammonium, the calcium thus displaced combining with the acid of the potassium or ammonium salt.

3. The humus contained in soil appears also to be capable of forming, to some extent, insoluble compounds with bases.

4. Some of the calcium salts contained in soil—probably the carbonate, the silicate, and compounds of lime with ferric oxide and alumina—assist in several ways the operation of soil-absorption. By combining with the acids of certain salts, as carbonates, sulphates, chlorides, nitrates, they allow the bases of these salts to unite with the hydrated metallic oxides. The carbonate of calcium also converts the soluble acid phosphates applied in manure into sparingly soluble calcic phosphates, which, as they gradually enter into solution, are converted into ferric and aluminic phosphates, as already described.

5. Lastly, besides these chemical actions of the ingredients of soil, several of the component parts of soil possess the power of attracting to their surface certain organic and sparingly soluble compounds, by virtue of simple physical adhesion. This power is apparently possessed by clay, by the hydrated metallic oxides, and possibly by humus. To the existence of this power the decolourizing and clarifying properties of soil are due.

The absorptive power of soil does not therefore reside in a single ingredient, nor is it to be attributed to a single action. Soils of very various character and composition may equally enjoy this important property. With clay soils the silicates and alumina will chiefly sustain the action; with loams and sandy soils the ferric oxide will play an import part; with pasture soil the action of the humus rises in significance. It is not to be supposed, however, that absorption in all these cases amounts to the same thing. The compound of a base with a silicate, with a metallic hydrate, and with humus, must, in every case, possess distinct properties, will probably resist in a different degree the solvent action of water, and be variously affected by other chemical agents. The difference

to the plant between these different compounds may, possibly be considerable. The relation of both the quantity and kind of the absorptive power of a soil to its fertility, and the influence of cultivation upon both aspects of this property of soil, is, I believe, a subject yet untouched, and can, perhaps, hardly yet be attempted until more perfect investigations have been made upon the elementary parts of this great question. These, we need scarcely say, are grievously needed. When will the country that owes so much to agriculture, and depends so greatly upon its successful pursuit for prosperity, perceive the importance of directly furthering such objects? Germany has its forty-five experimental stations, supported by the respective Governments, these establishments being devoted to the scientific study of agricultural questions. England, to the honour of individual effort, possesses one station (that at Rothamsted) which all admire, but none have imitated. The labours of our voluntary workers have contributed many valuable miscellaneous researches. The agricultural societies of this country, and the college at Cirencester, have also done good work; but for the task before them these institutions are, both singly and collectively, inadequate. Until, in fact, the prosecution of agricultural science is acknowledged to be an object worthy of national exertion, the thorough investigations which the subject demands can hardly be expected.

We unite in the suggestions made in the last paragraph, especially if the writer's views could be carried out in those of our colonies which depend on sugar as their staple. It is more than probable that the facility with which the beet root competes with the sugar cane is not only dependent on the perfection of the manufacture but equally so on the attention bestowed on the culture of the beet, and to the study devoted to the powers of the soil and to its preparation. The above and the former extract from Mr. Warington's work may seem but remotely connected with the object of our magazine, but we are persuaded that scientific agriculture of which the study of the absorptive power of soils is an important branch, must be applied to the culture of the sugar cane to ensure the continuous prosperity of the planter.—*Ed. S. C.*

THE WAR BETWEEN FRANCE AND GERMANY.

Compared with the deplorable consequences and the moral and political significance of a war, such as is now about to commence, its effect on the Sugar Industry of the Continent, and on the markets generally, is of very small moment; but the latter falls to our lot to note, rather than the former.

When we remember that of the 802,000 tons of last season, France produced 285,000 tons, and Germany (Zollverein) 215,000 tons, the probable effects of the war, merely as regards the Sugar Market of the future, will appear worthyof consideration.

It might have been expected that the Journals representing the sugar interest in France would have been the first to have looked the question in the face, from this point of view, but we do not find it so. "*La Sucrerie Indigene*" observes an ominous silence as to the war, but hints its disapproval of the increase of the duties on what the French call "*vehicules du Sucre*," of course as being likely to affect unfavourably the consumption of sugar.* The "*Journal des Fabricants de Sucre*" comments upon the war rather as regards its political and moral aspect, than from an economical or commercial point of view. The following is a literal translation of a portion of their *Bulletin* of the 20th of July:—

"War is declared, and all the pre-occupations of the country are towards our frontiers, where already a considerable army is united, and where a gigantic duel is about to be fought between two rival nations, who have only waited for an opportunity to measure their strength, which general politics have now offered them. The war is a horrible thing, but it must be allowed that since Sadowa it has been probable; and without seeking to justify the causes or the morality of the later incidents, the practical mind will acknowledge that whatever the solution, it must be decided by force. Moreover the armed peace is the ruin of our finances,

as it is fatal to all our projects of economical reform: if, as we hope will be the case, the actual struggle have the effect of reducing our military strength to proportions more in accordance with our financial resources, even if this be the sole result, it will be a great one. If the war end otherwise, it will be unjustifiable, and it is our hope, that as it must be a sanguinary and terrible event, that it will also be as transient."

If the general sentiments of both nations were as moderate as those of the editor of the "*Journal des Fabricants*," the war would be short indeed; but to return to the economical view of the question. The effects of the war will not perhaps be immediate, except that the exports from both countries will be reduced. Should the war be prolonged, there is no doubt but that the production of beet sugar will be *materially* lessened, and consequently the exports both of raw beet sugars and of refined goods to this country, considerably decreased.

On the other hand, the war will tend to divert some cargoes of colonial sugar from French to English ports, especially as there is now no drawback on French colonial sugar, which, up till within the last few months, gave it an advantage over beet and foreign sugars, on its import into France. Again, were the two belligerent powers of equal naval strength, the difference in the exports from France would be much greater, as it is, Prussia can make no attempt to blockade the ports of her adversary. Then we must not forget that a larger acreage, both in France and Germany, is now under beet culture than ever before, and moreover, that the consumption of sugar in both countries will probably decrease, as it is not so much an article of necessity as in England and some other countries. Yet, notwithstanding all these circumstances, the war, unless very "short, sharp, and decisive," must tend to give firmness to the market, although this effect may not be apparent for some time; but if the war is prolonged much beyond the next beet root season, an improvement in the prices of sugar will most likely be one of the results.

CHAMBER OF AGRICULTURE, MAURITIUS.
EXPERIMENTS ON CANE MANURES.

At a *seance* of the above institute held on the 4th of May last, a paper was read containing the results of some experiments on cane manures.

The writer after admitting that in consequence of the extreme dryness of the season during which his experiments were made, the results obtained were not so conclusive as he could have desired, goes on to state that the "complete" manure recommended by M. George Ville as being the best for the cane, gives results nearly equal to guano except in the more elevated districts, but that he noticed that chemical manures require more rain than when guano is used, as a proof of this he refers to an experiment made on some ratoons which having had very little rain were very poor, and on examination the manure which had been applied was found almost unchanged at the foot of each cane stool, whilst the guano which had been applied to some canes in identical conditions was found to be assimilated.

The writer states that the "complete" manure of M. Ville is composed as under:—

Acid phosphate of lime............	600 lbs.
Nitrate of potash	400 ,,
Sulphate of lime	400 ,,

and that so far as could be judged by appearance the cane patches manured with the above compost and guanoed the year following were superior to those treated with guano alone.

A more important fact which the inventor relates on his own authority is that a perfect cure of some "horribly diseased" plant canes had been effected in three months by the use of this manure, but he admits that it had been tried at different times on diseased *ratoons* but without effect.

In the higher part of the island it appears that the "complete" manure is much less successful than on the plains, but when the nitrate of potash was omitted and sulphate of ammonia was substituted the results obtained were equal to those of guano.

The soil of Mauritius being especially deficient in lime and potash

an experiment was made, which the writer of the letter thinks will prove that it is necessary to give to the soil all the salts which are found wanting in any given locality. For the experiment a square of 90 *lignes* was chosen and the results were as follows :—

30 *lignes* with 4oz. of guano to each stool gave 27 loads of canes.

30 ,, with 4oz. of a compost formed of sulphate of ammonia, superphosphate of potash, and sulphate of lime, gave 27 loads of cane.

30 ,, guanoed with 4oz. to each stool, with the addition of 2oz. of sulphate of potash and one pound of lime, gave 35 loads of cane.

The liming was done some time after the application of the guano; of course the carts were of the same dimensions in each case and regularly filled. Other experiments appeared to indicate that phosphoric acid should be abundantly used in cane cultivation, and the writer states that he agrees with M. Ville in the opinion that phosphate of lime is the chief manure for the cane, and that this plant as well as the maize and the sorghum takes its nitrogen from the air.

The results of the experiments given in detail by the writer of the paper appear to point to the fact that nitrogenous manures alone are little if any better than no manure at all, whilst some containing no nitrogen at all give very good results.

"If," says the writer, such facts were not contradicted by the marvellous results of guano, and by some experiments at Moka with sulphate of ammonia, which, science tells us furnishes the plant with nitrogen only, we should be quite of the opinion of the able chemist who has continued the doctrine of Liebig with so much talent and perseverance.

"Nevertheless we think that the superphosphates must play the principal part in the nutrition of the cane, and we believe that we are now able to recommend that it should be added to guano which although very rich in this salt does not contain sufficient to supply the quantity which the cane requires from the soil in this island."

"The mixture of chemical manures with guano appears to be the wisest measure we can recommend, because in times of drought chemical manures are so slow in assimilating and because their price will generally be lower than that of Peruvian guano."

THE SUGAR CANE INDUSTRY IN ANTIGUA.

It may perhaps interest some of the readers of *The Sugar Cane* to hear of the practice of cane cultivation, and sugar manufacture, as common in Antigua,—an island proverbial for stiff black soil, good husbandry, good molasses, and *lately* bad sugar.

Notorious as it is that Antigua has always kept pace with, if not overrun, her sister isles in every improvement connected with the social, political, and *strictly* agricultural interests, it is nevertheless true that she still remains side by side with those colonies remarkable only for imperfect manufacture.

The Preparation of the Land is nearly identical in all parts of the island (with perhaps the exception of the lighter soils of the Popeshead district), and consists of ploughing, crop ploughing, banking, subsoiling, and crop holing—the manure from the yard or field pen is carted on the land, and either ploughed in, laid in straight plough furrows from five to six feet apart, and the bank turned upon it by the plough; or placed by the basket every four feet in the furrow between the banks, and the crop bank made by the hoe is then used for covering it. That each plan has its advocates it is reasonable to suppose, but the majority of planters prefer ploughing in, particularly when the manure is not thoroughly decomposed, not limited in quantity, nor the season advanced. With this plan every inch of the field gets a share of the farm yard, and in greater abundance than could be otherwise covered. Manuring under the plough bank, and under the hoe bank have also been much praised as having a more immediate effect, as well as greatly economising material; and there are also a few planters (but I am glad to say *few*) who believe that in placing the manure about, and immediately around the growing canes, they do everything necessary for the nourishment of the plant; nothing can be said in favour of this—it is wasteful, expensive, too stimulating except in very wet weather, and decidedly injurious to concentration. Many years ago it was the practice immediately after preparation to place the manure in the bottom of the holes, where it was carefully covered

with mould and allowed to decompose. In no part of the world could this mode of manuring be considered beneficial, and the ill effect on the germination of the plant placed in this hot-bed was made apparent by the difficulty that always existed in establishing fields so treated.

Planting—vertically or nearly so, by means of a pointed drill is almost universally adopted, experience having proved that the plant grows more readily, goes deeper and firmer into the soil, and is not so likely to die out during the dry months; but it still remains a question if the young shoots are as numerous, the canes as luxuriant, or the bunches as large as when the horizontal or *hoe* planting was in favour. December, January, and February are the planting months, the last as good as any, if we could with any certainty calculate *then* upon the showers necessary; but as it is generally dry here about that time, we prefer to have in the plants about a month or six weeks earlier. For five or six years past there has been a marked improvement in early preparation, most estates have had all their lands opened by the end of December, and some indeed even earlier. No point in tropical agriculture is more essential than *long fallow*—the fields ought to be prepared by the end of October or beginning of November, but we must not on that account, or from the soaking showers that usually fall about this time, be tempted to plant;—"a month's fallow is a month's growth," and it has besides been proved beyond doubt that October and November canes invariably suffer during the dry or crop season, in some cases they do not recover even *after* the rains set in, but remain stunted, ill looking, and dry. The arrow *per se* is not however looked upon as an objection to early planting. Our forefathers knew that arrowed canes made the best sugar, because the plant had come to perfection; *we* know they do not burn up, or the tops drop off, as in the *prematurely ripened*; and who will dispute that a long cane with an arrow is not more profitable than a short cane without one?

Proportion.—The generality of estates prepare and plant annually a third of the land, the remaining two-thirds in ratoons and fallow; or perhaps yams, guinea corn, or some green crop for the purposes

of a manure. This system is considered adapted to the soil, for as the land quickly sets, a second ratoon can hardly be reckoned upon without the aid of artificial manure, or very favourable weather; it is still however questionable if the Barbados half system might not prove *most* profitable on some of the smaller places.

TRASHING the young plants from an adjoining field is also adopted, and perhaps with justice considered of material benefit, it interferes however with the action of the small plough, and on that account may be thought objectionable. On some places the trash is spread on the land before the canes are planted, but here unless the weather continues very wet, crickets and other insects infest the ground, and after planting eat down and destroy the young shoots as fast as they appear; it is therefore preferable not to trash until the canes are strong and rather above the banks.

PONY PLOUGH OR CULTIVATOR constantly in operation on the banks between the growing canes during dry weather has also come into general use, and with the system of farming* perhaps done more for our thirsty and cracking soil than any plan yet introduced. What can be more reasonable than keeping the land loose, free from cracks and ready to receive and retain the smallest shower? And what more certain to benefit a plant thirsting for moisture than deep tillage? After every operation of the plough in very young canes, it is however very important to have any displaced mould drawn up, otherwise the banks might be too early levelled and the hole so necessary to the well being of the tender plant would be in time completely effaced. The benefit from the plough or cultivator is everywhere apparent, and the good effect always more telling in dry seasons. The plough with the mould board removed is generally used in the plant canes, as when the implement is complete it throws over the earth too heavily, and is then only suitable for ratoons

RATOONS.—It is usual immediately as the canes are carted off the fields, to clear the trash from about the stools, by placing it on the

* Laborers employed and paid weekly to weed and crust over the whole or parts of a field, they are generally remunerated at so much *per acre*, and contract to *keep* those portions *entirely* free from weeds or cracks.

banks; this allows the shoots to find their way out more readily, and at the same time facilitates the operation of hoe moulding. Some planters place all their trash upon every alternate bank, and the plough is then made to throw the mould from the land thus cleared on to the stool, the trash is again replaced on the broken land, and the next row remains clear for the plough. There are many persons adverse to the plough moulding of ratoons, but it must unquestionably be of great benefit, particularly when done early before the stools begin to shoot. Such tillage is well adapted to stiff and heavysoils, and must tend materially to ensure a second crop.

Standovers; or leaving late planted fields uncut is now, happily, nearly a thing of the past—having to be reaped during the wet season, they yield badly, waste fuel, make poor sugar, and throw the general work of the estate into great disorder. Manufacture in the appointed months, satisfied with the single error in planting late, rather than add another mistake by leaving any portion of the crop uncut; the profit gained on the ratoon will really more than double any apparent advantage in leaving stand-overs.

There is an improvement to be mentioned which has not yet reached our fields. I allude to the Flemish mode of moulding adopted in Barbados and some of the larger islands. On *heavy land* it would be beneficial, and nearly equal to steam ploughing; but as it is performed by manual labour, we have not been able to give it a fair trial.

Antigua, then as I have endeavoured to show, is as far advanced in agriculture as any other colony. The plough is essential, and well suited to her wants; she employs largely; and lately by the aid of steam, the accumulation of years in the subsoil has been awakened and brought to light. Improved tillage everywhere, and acre after acre without a weed, demonstrate her first-class husbandry. Her luxuriant and highly saccharine cane yields also a juice, which *ought* unquestionably to make good sugar. But unfortunately it is here that we fall short, and here so much room for improvement, either on our present system, or in the adoption of more costly scientific and modern appliances.

In my desire to point out some of the essentials to good manu-

facture, I request a patient hearing, feeling sure that all will agree in the necessity of deeply considering, and giving *thorough* ventilation to a subject that calls loudly for attention.

The system of job or task, until lately the usual mode of taking off the crops, has done more injury to quality than will be recovered in years. It has renderd the laborer careless and slovenly, and even under the present improved day hire it is difficult to eradicate the seeds already sown, and almost impossible to return to those wholesome rules, so necessary to ensure *a bright* muscovado. The extra care and watchfulness required *now* to secure a fair proportion of work, ought not however to tempt us to retire from the stand already taken, but an inducement, rather, to determinedly press forward and conquer.

Reaping or Cutting.—In cutting the cane it is requisite to insist upon the trash being taken off first, particularly from the upper part where it adheres firmly and conceals the exact spot at which the reed ought to be severed. If this precaution be not observed, on some canes we shall find too much top and on some tops too much cane; in the former case the juice expressed from the upper or immature portion injures the quality of the sugar, and in the latter the waste is lamentable. Attention is also necessary to prevent the canes from being divided into too many pieces, as this tends to create acidity, by allowing the air to act upon the cut ends. And in binding or tying, the canes should be entirely freed from trash or mould, then packed in heaps, and not laid in single bundles for the sun to injure or the carts to drive over. Trash taken to the mill on the cane, not only assists in adding considerably to the impurities of the expressed juice, but chokes the pump, delays the work, and endangers the safety of the machinery. What excuse then can there be for giving us cause to mistake a load of canes for one of trash? or of cutting and spreading out to the action of the sun, more than double the number of loads that can be immediately ground? Surely it ought to be remembered that cane juice deteriorates rapidly, *even in its parent cell,* and every precaution should be taken to ensure *instant* manufacture. When Antigua made bright muscavado, these *now* apparently minor points were

most scrupulousley attended to. No planter then would risk his situation, by leaving over twelve loads either in the field or yard. Cleanliness was also strictly observed, and the rollers, receiver, pump, &c., *daily thoroughly washed*; the lime brush was then passed over, but not before the parts were quite dry. Pump action so decidedly injurious to cane juice, has also with the introduction of steam come into general use, where in the majority of instances by a little attention and forethought the liquor might have been made to flow directly to the simmerers in a full stream, and the harm done by churning, or the constant trickle of a small quantity at once avoided. When practicable, the receiver may be double bottomed, and a jet of steam allowed to act upon it, so that the juice would be warmed as fast as expressed.

Simmerers or Clarifiers.—Where the first are heated by *flame* it is necessary to have them either of copper, or to be most particular in preventing fire being placed under them before they are quite full, otherwise we shall be defeated at our first step by charring and discolorization. Steam tube clarifiers although very costly, will in conjunction with other steam machinery quickly repay the outlay; their certainty and perfect defecation place the juice if properly treated, in the most favorable condition for concentration.

Tempering.—Before tempering it is always advisable to apply a thick batter of clay, and this in quantity and consistence depending upon the separation, as well as the strength and nature of the juice; or a batter of whiting may be similarly added as being more miscible and easier handled; but if clay is used care must be taken in having it thoroughly dry and pulverized before mixing, or a large proportion will remain in lumps undissolved, and more than half the influence lost. Bring the juice then almost to the simmering point before adding the lime, and do so cautiously, watching the test glass with every addition of temper, until a perfect and tight separation is effected. By tempering at a *high* temperature *less* lime will be required, and its ill effects consequently lessened, and as it is essential to use fresh lime, care should be taken in burning, and afterwards excluding it from the atmosphere.

(To be continued.) F.

THE EFFECTS OF THE WAR ON THE SUGAR INDUSTRY OF FRANCE.

Since the article on the war between France and Germany was in type, we have received (just before going to press) the latest number of the *Journal des Fabricants de Sucre*; having taken time to consider, it thus speaks of the probable effects of the war on the sugar industry and commerce in France.

"In the first place, of material disasters we have little to fear, in the departments in the east where the armies of the Rhine are concentrated there are few or no sugar factories. There are three in the department of *Meurthe*, one at *Pont-a-Mousson*, one at Champigneulles and one which was only established this year, at *Nomeny* near *Nancy*. These factories are in danger of seeing their supplies of beet destroyed by the infantry, or serving for fodder for the horse, let us hope not the Prussian horse. In *La Marne*, *Les Ardennes*, *L'Aisne*, are a great number of sugar factories which can only suffer in the very improbable case, of the invasion of France. It may be that in certain localities of these departments the beet root crop may be slightly damaged by the march or the concentration of troops, but when the harvest, nearly ready on all sides, is commenced, this inconvenience will be diminished. Our *usines* in general and our Parisian refineries especially may suffer by the want of hands, by their *personnel* being occasionally called away to the reserves and the guard national; or by the removal of subjects of Prussia or its allies. We have nevertheless no anxiety as to the execution of all the work during the proper time, for necessity will cause a forced economy in labour, and we must not forget that in ordinary times the number of workmen is being constantly reduced.

From a commercial point of view; German sugar will cease to compete with us in the English markets, which it can no longer reach except by a costly circuitous route, the blockade of the Prussian ports being in all probability very effective. The freight of colonial and foreign sugars transported in French ships will be augmented, and react on freights in general, and thence on the price of sugars coming to French ports. The exportation of refined and raw sugars to the east, momentarily hindered, will not submit to any serious impediment, as we have nothing to fear from the Prussian marine.

The trade in sugar must like all other branches of commerce or manufacture submit to the inconvenience of increased rates of discount and to the restriction of credit, but in short no direct or special cause menaces it and the consumption itself augmented by the needs of the army will not have to suffer any diminution.

The uncertainty of events may restrict business, but this is one

cause which each will determine for himself. But we do not think the sugar industry and commerce will have to suffer specially from unforeseen events in the terrible crisis through which we are passing.

IMMIGRATION TO THE SANDWICH ISLANDS.

THE king of the Sandwich Islands, Kamehameha, in his speech at the opening of the legislative assembly, mentioned to the deputies some measures which he thought calculated to induce the development of the culture of the sugar cane to a state of great prosperity in their country. "The committee on immigration," said the king of Honolulu, "has completely executed the wish of the legislature as it was formerly expressed during the last session concerning the immigrants from the islands of Polynesia. But after two expeditions, experience has tended to show that it is not in these islands that our population can find the elements of a considerable and permanent addition."

On this head the reply of the chamber contained the following passage:—"We are happy to have to acknowledge the zeal with which the committee on immigration has executed the wishes of the former legislature; if the duties of this committee continue to be assiduously carried out, there is no doubt but our country will derive immense advantages from the introduction of a larger number of labourers into the sugar-cane plantations. We are convinced the committee will be successful."

It is labour which is wanted to increase the production of sugar in the Sandwich Islands, now estimated at from 12,000 to 15,000 tons per annum, which finds a ready outlet in the United States.

The Sandwich Islands with their fertile volcanic soil and their excellent market may augment their production in large proportion; what they chiefly want is manual labour, and this explains the great importance which they attach to immigration.

It is remarkable that in nearly every one of the countries where the sugar cane is cultivated there is a deficiency of labour. On all sides it is necessary to import labourers, and Egypt is the only one which, notwithstanding the increasing importance of its production, is an exception.—*Journal des Fabricants.*

METHOD OF DETERMINING THE EXACT SACCHAROMETRICAL VALUATION OF SUGAR EVEN WITH AN INEXACT INSTRUMENT.

(*From the Zeitschrift.*)

To avoid the cause of error proceeding from the inexactitude of the polariscope, which chiefly arises from the form of the moveable angle of quartz, a method of double observation is recommended, of which the following are the chief points:—

Weigh the exact quantity of the sugar to be analysed, that is to to say, 26·048 grammes for the German instrument, or 16·35 for the French polariscope, each of which is dissolved to the volume of 100 c. c., then clarified, and submitted to observation as usual. Suppose that the average of several observations shows 92·6° on the scale of the polariscope, that is to say, 92·6 per cent. of pure sugar. This result will be exact, if it has not been affected by any error arising from defect in the angle of the quartz near the point of observation.

To prove the correctness of this, a second trial is made by submitting to observation sufficient sugar to produce on the instrument a deviation to the right of 100°. The quantity is calculated in our example by the following proportion:—

For German instrument.

$$92{\cdot}6 : 100 :: 26{\cdot}048 : x.$$

$$x = 28{\cdot}130.$$

For French instrument.

$$92{\cdot}6 : 100 :: 16{\cdot}35 : x.$$

$$x = 17{\cdot}656.$$

Then 28·130 grammes for the German instrument, or 17·656 grammes for the French instrument, of the sugar are weighed, and dissolved to the volume of 100 c. c., and this will give exactly 100° to the right on the scale of the polariscope, if the first determination is correct, *i.e.*, if the sample contains exactly 92·6 of pure sugar.

In all other cases where a different number than 100° is given, the real proportion may be very exactly found from the figures shown.

Thus, for example, if the second observation, instead of giving 100°, should only have shown 99·7, the real saccharine richness may be found by the following proportion:—

$$28{\cdot}130 \ : \ 26{\cdot}048 \ :: \ 99{\cdot}7 \ : \ x$$

$$x = 92{\cdot}32.$$

instead of 92·6, which was given by the first observation.

If we had found on the second observation 100·4 instead of 100, the proportion would be as under.

$$28{\cdot}130 \ : \ 26{\cdot}048 \ :: \ 104{\cdot}4 \ : \ x$$

$$x = 92{\cdot}97.$$

Which gives the real richness.

For the French instrument the calculations would be as follows:

$$17{\cdot}656 \ : \ 16{\cdot}35 \ :: \ 99{\cdot}7 \ : \ x$$

$$x = 92.32.$$

$$17{\cdot}656 \ : \ 16{\cdot}35 \ :: \ 104{\cdot}4 \ : \ x$$

$$x = 92.97.$$

The results given by the second observation are always more just than those of the first, because the figures in the second are in immediate proximity to the point 100°.

Evidently the discrepancies of the valuations of different chemists which take place in consequence of the different inexactitudes of the angles of quartz in their instruments, need never take place if the points 100° of their instruments are exactly right. It is as easy as it is necessary to be sure of the just position of the point 100°, or to find, and then to apply, the quantity of pure sugar, of which which 100 c. c. shall mark 100° on each instrument.

Once the quantity of sugar corresponding to this point (100°) is accurately fixed, there will be no further excuse for inexact determinations from the fault of the instrument, but by this method of double observation the exact figures may be found.

STATE OF THE BEET ROOT CROP.

From La Sucrerie Indigene, 20th July.

THE last rains being more general have made a great improvement in the situation of the growing beet root, that from the first sowings is later than it should be, but it is beautiful and vigorous even in those soils which only yield a poor return; in the north, which we have visited within these few days, it is magnificent. The last sowing has shown many of the irremediable failures formerly spoken of. In short, so far as we can see the situation leads us to expect a sufficiently abundant crop.

From the Journal des Fabricants, 21st July.

The weather continues to be favourable to the beet root and although the week's rain that we have had may be insufficient it has however reanimated the vegetation of the saccharine plant, which is developed slowly, but is in good condition.

The first beets look well and their leaves have that dark green tint which denotes vigour. The latest sown are everywhere very late, and show irreparable failures, although in many respects the plant has come on better than could have been expected.

In general, the plant not having found the humidity at the surface of the soil has not forked in a number of lateral roots, as is the case sometimes. The principal root has forced its way well into the soil, which is one of the best conditions for its later development and especially for its saccharine richness which it is impossible always to ensure.

There will be without any doubt a notable deficit as we have said on a fourth or fifth of the crop, of which the final result is still doubtful, but after suffering from such a terrible and long drought the situation is not bad and might have been much worse.

From the Journal des Fabricants 28th July.

The drought has returned for a fortnight, with days such as last Sunday, when the thermometer was 96° in the shade: the dryness, which is decidedly the character of the season, is too greatly prolonged, and fears begin again to be felt for the beet crop.

Not that the greater part of the crop, that is to say the earlier sown, which is principally in the North and the Pas-de-Calais,

that will be in bad condition. But the latest sown has suffered much, and for all there is to be feared that an early ripening followed by the late rains may have caused a fresh vegetation, which will take from the plant the saccharine qualities which it has acquired during the hot dry period.

PETITION TO FRENCH LEGISLATURE ON THE SUGAR DUTIES.*

THE following petition relative to the reduction of the sugar duties has been presented to the *Corps Législative* by the *Chambre Syndicale de Commerce à Exportation et de Commission.*

TO THE MEMBERS OF THE CORPS LEGISLATIVE.

GENTLEMEN,

The committee of the chamber of commerce begs to call your serious attention to the legislation by which the sugar industry is regulated, and solicits a reduction of the heavy duties to which this industry is subjected.

Sugar has become almost a necessary required by all classes of the population. To encourage the production of sugar by promoting the consumption, is not only to satisfy a want but also to help to develope agriculture, which furnishes to this industry its raw material, to promote the prosperity of the shipping trade by which the sugar is conveyed, and also to provide work for manufacturers of machinery by whom the factory apparatus is provided.

The high duties which oppress the article of sugar in France restrain the production, lessen the consumption, and damage the export trade. There is scarcely anything in our tariff more heavily taxed.

For example, sugar No. 12 the commercial value of which on 31st May was 62 francs per 100 kilos., pays to the State 42 francs per 100 kilos.; and sugar No. 3 worth 75 francs pays to the State 45 francs, that is 60 per cent. of its value; the ratio of the duties increases in inverse proportion to the value of the sugar assessed.

* This petition was presented, and the translation was in type some time before the war was imminent.

Under this regulation the consumption of sugar in France reaches scarcely 8 kilos. per head.

In England, under the influence of successive reductions in the duty, which do not exceed 13 francs on sugar assessed with us at 42, the consumption has increased to 20 kilos. per head; in 1869 it reached 59,392,000 kilos. (596,000 tons), and the nett proceeds to the treasury were 134,300 francs.

The government of the United States itself, appears to wish to except from its rigorous and excessive system of protection in favour of sugar, and the Chamber of Representatives at Washington has very recently adopted the bill which reduces the duty on sugar of the first quality to 2 cents per pound. The consumption is nearly equal to that of England.

The reduction of the duty would produce the same effects in France, we should see the production increase and the consnmption attain the limits it has done in England and the United States. The treasury would find in this surplus a compensation for the diminution in duty.

The committee of the Chamber in addressing itself to the Corps Legislative for the purpose of requesting a reduction on sugar, is convinced that it is asking, from the representatives of the nation, the initiation of a liberal and democratic measure which would satisfy the wants of all classes and especially the poorer classes, would increase national manufacture, and develope our export commerce.

The committee ventures to hope that you will be pleased to receive with favour the petition which it has the honour to present to you.

Accept the assurance of our high consideration.

The Sugar Duties in America.—The Senate of the United States have rejected the law reducing the duty on sugars which some time ago was passed by the Chamber of Representatives by a large majority.

THE WEATHER AND CROPS IN BARBADOES.

From the West Indian of June 24th.

There have been partial showers during the last fortnight, which have revived the young canes and enabled the planters to plant corn, yams, &c. without much interfering with the reaping of the old canes, as the crop is closed on all but a very few estates. The young canes promise well, and there has been a large planting of provisions. But more rain is wanted to bring them on. The shipment of the crop has been expedited, and up to date amounts to 25,929 hhds. sugar and 9,348 puns. molasses. We are happy to add that we have had heavy showers to-day over the town, with every appearance of extending further. They were much wanted especially in this parish, not only for the young canes and the planting of provisions but also for the springing of the grass and the growth of guinea corn and other kinds of fodder for cattle.

We republish from a late issue the crop of St. Lucy for 1870. It shows a total of 3081 hhds. of sugar from 1565 acres under canes, or nearly 2 hhds. per acre. In St. Joseph the crop amounted to about 3,500, which is considerably in advance of the crops of the parish for the last two years, as shown by the following returns. It will be observed that 170 tons of guano were applied in St. Lucy to produce the crop.

1868 the crop reaped	2811 hhds.
1869 ,, ,, ...	2370 ,,
1870 ,, ,, ...	3500 ,,

From The West Indian July 8th.

The crop may now be considered closed. It was expected to reach 40,000 hhds. and if it does not come up to that figure, it cannot be far from it. Up to the present time 29,515 hhds. have been shipped. The quantity of molasses shipped, about 10,500 puns. The young crop promises well, it is particularly forward in the Below Cliff District. For the present it wants rain, although there was a fall in June much over the average, in St. Joseph the guages showing

from 13 to 20 inches during the month. A large breadth of provisions, Indian corn, yams, eddoes, potatoes, &c. has been planted, and all look well. On the whole agricultural prospects are favourable. There is sufficient employment for the labourers in the field, with wages at the ordinary rates, and American bread-stuffs, on which the whole population depends for subsistence, not higher than usual at this season, when all our native provisions are exhausted.

From the Agricultural Report of St. Joseph's.

THE old cane crop completed through the parish during the month, is in excess of that of last year by 340 hhds., the numbers being for 1869, 2430 hhds.; for 1870, 2770 hhds.; the sugar made during the last four weeks was much weaker and boiled away and sunk much in the hhd., requiring a good deal of ramming and filling up.

The young cane crop had quite recovered itself at the close of the month and was looking green and healthy and in some places Below Cliff was rather *too forward.* The ratoons, on the whole, have sprung well, although in some places they have died out, and required supplying.

Provision crops, viz., yams, eddoes, potatoes, corn, and grain have been extensively planted since the rains, so that there is a prospect of abundance of the native food in the next three or four months. Potatoes have been selling at 6 lbs. for 5d.

The stock are only now getting dry cane tops, but will be able to browze some grass in a few weeks.

From a correspondent of The West Indian.

IT seems that success depends more on the quantity of stake manure applied regularly every year than on guano, and that we are overrating the value of the latter article, and of later years where liberally applied disappointment has been the result. When guano was first imported into this island, we got a genuine article at 48 dols. per ton, while now with more gloomy prospects than ever

threatening the West India Islands, we are paying 65 dols. per ton for a far inferior article.

I have often heard it said that at some planters' meeting soon after the introduction of guano in this island, a gentleman in a speech of some length expressed a hope that the day was not far distant when we would be able to carry as much manure in our waistcoat pockets, as would manure an acre of land. Another in reply stated that in his opinion, whenever that day arrived, the other pocket would be quite sufficient to hold the sugar the acre of land would yield, which late experience has proved to be a correct idea.

New Method of Estimation of Grape Sugar.—K. Knapp.—This method is based upon the fact that an alkaline solution of cyanide of mercury is completely reduced to the metallic state by grape sugar. The method is executed as follows:—10 grms. of pure and dry bicyanide of mercury are dissolved in pure distilled water; to this solution are added 100 c.c. of caustic soda solution (sp. gr., 1·145); and, next, as much distilled water is added as will be required to make a bulk of 1,000 c.c. A series of experiments made by the author brought to light the fact that 400 milligrms. of cyanide of mercury are, when in alkaline and boiling solution, completely reduced to metal by 100 milligrms. of pure grape sugar. The titration is done as in Fehling's method—40 c.c. of the alkaline cyanide solution are boiled in a porcelain basin; and the sugar solution (not stronger than about half a per cent.) is added until all the mercury is precipitated. In order to test the course of the operation, a single small drop of the fluid is put upon a piece of Swedish filtering paper stretched over the mouth of a small beaker-glass, while the bottom of that glass is covered with rather strong sulphide of ammonium. As long as any cyanide remains undecomposed, a brownish spot will appear. The author states that, with a little practice, even 1-10th c.c. of the above dilute sugar solution can be readily estimated.—*From the Chemical News.*

SUGAR CANE AND BEET ROOT CULTURE IN SPAIN.

The cultivation of the sugar-cane in Andalusia and that of the beet root in the Castiles has for some time past been very greatly extending.

These cultures, principally comprised between Adra and Marbella on the sea coast, occupy a space of 20 to 26 leagues in length by many kilometres in breadth. The produce supplies 14 factories, of which the annual return is estimated at nearly 14,000 tons.

Up to the present time the plantations and the refineries have given very good results. The culture of the sugar-cane has been in some parts substituted for that of cotton and in others for that of the vine, especially in the provinces of Almeria and Grenada. The number of sugar factories is rapidly increasing. Four new refineries are now in actual installation, the machinery for which, we are informed, has chiefly been ordered from a French house, but we believe that English engineers have at least equally participated in these orders.

INTRODUCTION OF THE STEAM PLOUGH INTO L'AISNE.

In our plain of Laon says the *Journal de l' Aisne* the culture is not behind that of any other in the improvements inaugurated and the adoption of methods which indicate real progress.

We have already seen on the estate of M. Bazin some trials of steam ploughing by one of those powerful machines which have made the name of Fowler famous. In the next season another steam plough by the same maker will be at work on the estate of M. Fouquier d' Hérouël, the able and intelligent agriculturist, who has already shown to our canton such proofs of enterprise and perseverance. M. Fouquier d' Hérouël has also ordered in England an apparatus for the dessication of cereals and cattle fodder.

NOTICES OF BOOKS.

On the Manufacture of Beet Root Sugar in England and Ireland. By William Crookes, F.R.S., Editor of "The Chemical News." London: Longmans, Green & Co. 1870.

The object of this work is to promote the cultivation of the Beet root, and the manufacture of sugar therefrom, in England and Ireland. The author is fully competent for the task he has undertaken, as may be assumed from the concluding paragraph in the Preface:—

"Nearly twenty years' experience at technical examinations in the laboratory, and as scientific adviser in the manufactory, has made the writer familiar with the numerous branches of this important technology; and his long-formed conviction, that its introduction into England and Ireland would be a subject of great national importance, has made him enter with pleasure upon the task of preparing this work for the press."

We are told in the Introduction, that, in the year 1867, we imported from the continent of Europe 55,000 tons of beet-root sugars, and paid £1,600,000 for what it is now believed we could just as well have produced ourselves. It is very probable that the amount of our imports of beet-root sugar during the present year will be much larger, and this economical argument is very strong provided it can be shown that the capital and labour required could not be exercised more advantageously in other productions; and in his endeavours to prove that the beet sugar manufacture would be a profitable employment of capital, the author's estimates of expenses and returns are we think carefully made.

The modes of culture of the Beet as practised on the continent of Europe, are fully described; and the position is maintained that a great part of England and Ireland are equally adapted to the growth of the Beet with most of the countries where it has been successfully carried on,

Mr. Crookes not only enters fully into the cultivation of the Beet, but also into the manufacture of the Sugar; the technology, the chemistry, and the various methods of defecation, evaporation, &c., being comprehensively treated.

The chapter on decolorization, which is equally applicable to sugar from other plants than the Beet, contains much interesting information on animal charcoal.

Altogether the book is of an exhaustive character, and calculated to be of great use to those who, contemplate entering into the beet-root sugar industry in England or Ireland.

The Malay Archipelago—the land of the Orangutan, and the bird of Paradise; a narrative of travel, with studies of man and nature. By Alfred Russell Wallace. London: Macmillan & Co., 1869.

These volumes contain the narrative of several years' travel of a naturalist who was engaged in collecting specimens chiefly of birds, beetles, and butterflies, in which he appears to have been very successful, but his studies of nature do not appear to have included the sugar cane, although he must have constantly visited places in which it was the chief culture. But his object was of course to study the rare rather than the common, and his volumes are very interesting even to those who cannot share in his enthusiasm for natural history.

Mr. Wallace's visit to Java appears to have been particularly satisfactory, and his opinion of the Dutch government of the island and the method of obtaining sugar and coffee from the natives very different from the views generally entertained in England. He says—

"The mode of government now adopted in Java is to retain the whole series of native rulers, from the village chief up to Princes, who under the name of Regents are the heads of districts about the

size of a small English county. With each Regent is placed a Dutch Resident or Assistant Resident, who is considered to be his 'elder brother,' and whose 'orders' take the form of 'recommendations," which are however implicitly obeyed. Along with each Assistant Resident is a Controller, a kind of inspector of all the lower native rulers, who periodically visits every village in the district, examines the proceedings of the native courts, hears complaints against the head men or other native chiefs, and superintends the government plantations. This brings us to the 'culture system' which is the source of all the wealth the Dutch derive from Java, and is the subject of much abuse in this country because it is the reverse of free trade."

"The system introduced by the Dutch was to induce the people through their chiefs to give a portion of their time to the cultivation of coffee, sugar, and other valuable products. A fixed rate of wages—low indeed, but about equal to that of all places where European competition has not artificially raised it—was paid to the labourers engaged in clearing the ground and forming plantations under government superintendence. The produce is sold to the government at a low fixed price. Out of the nett proceeds a percentage goes to the chiefs and the remainder is divided among the labourers. This surplus in good years is something very considerable. On the whole the people are well fed and decently clothed; and have acquired habits of steady industry and the art of scientific cultivation, which must be of service to them in future. It must be remembered that the government expended capital for many years before any return was obtained; and if they now derive a large revenue it is in a way which is far less burdensome, and far more beneficial to the people than any tax that could be levied."

The author admits that this system is not always perfectly carried out, and that the "Residents" sometimes oppress the people; but asserts that on the whole the system has worked well, which is shown conclusively by the rapid increase in the population. The present system of raising a revenue by the cultivation of coffee and sugar sold to Government at a fixed price began in 1832. The

census taken a few years before showed the numbers to be 5½ millions. In 1850 the population had increased 73 per cent., and then reached 9½ millions; in 1865 it amounted to over 14 millions —an increase of 50 per cent. The average to the square mile is double that of the Bengal presidency, and one-third more than that of Great Britain and Ireland. Mr. Wallace believes this large population to be on the whole contented and happy.

It has been said that except in Egypt, wherever the sugar-cane grows labour is scarce—this does not appear to be the case in Java.

The following extract is nearly the only one in which the sugar cane is mentioned. Mr. Wallace was in the Aru Islands, which are very seldom visited by Europeans, and thus describes how the sugar-cane is used there.

"The black vegetable soil here overlying the coral rock is very rich, and the sugar cane finer than any I had ever seen. The canes brought to the boat were often ten and even twelve feet long, and thick in proportion, with short joints throughout swelling between the knots with their rich juice. At Dobbo they get a high price for it—as much as 1d. to 3d. per cane; and there is an insatiable demand among the crews of the praus and the Bata fishermen. Here they eat it continually. They half live on it, and sometimes feed their pigs with it. Near every house are great refuse heaps of cane, and large wicker baskets to contain this refuse as it is produced form a regular part of the furniture of a house. Whatever time of day you enter, you are sure to find three or four people with a yard of cane in one hand, a knife in the other, and a basket between their legs, hacking, paring, chewing, and basket-filling with a persevering assiduity which reminds one of a hungry cow grazing, or of a caterpillar eating up a leaf."

This appears to be the only use made of a very fine variety of cane indigenous to the Aru Islands. We cannot but regret that the author did not take some interest in the cane as a culture: he might then have supplied valuable information respecting it, and even have been the means of introducing some new and fine varieties of cane into Java or the Philippines, from whence they would have been further extended.

Correspondence.

To the Editor of the Sugar Cane.

Sir,

Referring to page 116 in No. 7, allow me to say that you were *not* mistaken in speaking of my Concretor as the first introduced into Australia. Those on the Clarence and Macleay were not erected so soon as mine (which was at work September 26, 1869), and they were merely tried for a few hours and then closed till the sugar season of 1870: whilst mine continued at work, and has made over 60 tons of *sugar*. If there be any merit in priority in such a matter, I think I am fairly entitled to it.

Yours, Mr. Editor, truly,

JNO. C. NEILD, M.D., &c.

Port Macquarie, May 7th, 1870.

Rouen (Saint-Sever), 12th July, 1870.

To the Editor of the Sugar Cane.

Sir,

In reading over the letter addressed by M. de Merjencourt to M. Lauriol on the subject of the results obtained by M. Pasquin with Fryer's patent Concretor at Guadeloupe, a letter which appears in the number of June, translated from the *Journal des Fabricants de Sucre*, I notice that you make a mistake in the appreciation of the value of the produce, in that you make the value bear on 100 kilos. instead of on 50 kilos., which is the basis of French *colonial* valuation, so that the concrete obtained was estimated 2s. 6d. per cwt. superior to *bonne quatrieme* instead of 1s. 3d., as you put it, and the centrifugaled concrete 7s. 6d. per cwt. instead of 3s. 9d.

I send you to-day the number of *L'Avenir*, of Guadeloupe, in

which the above letter originally appeared. It is followed by some observations which the *Journal des Fabricants* did not insert.

I remain,

Yours very truly,

GEO. BLAKE OUGHTERSON.

We refer our readers to the letter mentioned by Mr. Oughterson in our June number, and add below a translation of the editorial remarks which accompanied the original publication of the letter in *L'Avenir Journal de la Guadaloupe* of the 15th April. After the letter the Editor observes :—

"This letter needs no comment; it emanates from a man worthy of all confidence in his statement of facts, of which, besides, he has not been the sole witness.

"We rejoice at this success, in the general interests of the country, because we hope the Concretor will be of more benefit to the cane planters than they have yet received from the central factories; because we think that the Concretor will compete with the *usines*, and that then these latter now established will be a little more liberal, or rather a little more equitable, with regard to those who bear the burden of the day, and who supply the raw material which it costs them so much to produce.

"We have said it from the commencement, we will say it again: *The Central factory is a grand progress, but in order that the country should prosper it is not sufficient that some manufacturers and capitalists make fortunes;* it is necessary that the cane planter should live, it is needful that he should receive sufficient remuneration for his time, his trouble, and the risk of his capital engaged, and this remuneration seems to us insufficient if he only receives 5 or 5½ per cent. of the weight of his canes (in sugar).

"The success of the Concretor is nothing less in our view than a revolution in our country, and we ought to receive with goodwill those who come to accomplish it so energetically and courageously.

"On this subject, although not very competent judges, we must offer an opinion which we submit to the attention of those who are about erecting the Concretor.

"We think that in a country like ours, where the machinery wastes almost as quickly as the mills devour the cane; in a country where labourers are scarce, expensive, and not always tall enough for the tatches, it will be best to simplifiy everything as much as possible.

"In a word, we think it will be best to keep to making concrete sugar, not centrifugaled."

NEW PATENT.

W. Hosack, Montpelier, Jamaica. *Improvements in Evaporating Liquids, and in the Means or Apparatus employed therefor.*

This invention, which relates to the effecting of a more rapid evaporation of liquids with less loss of heat than is obtained by existing methods, is applicable for the evaporation of liquids in general, but one of the applications for which it is specially adapted is the evaporation of the liquor from which sugar is manufactured.

In place of evaporating the liquid in bulk, as hitherto employed under the present invention, the evaporation is effected when the liquid is in a finely divided state of drops, jets, or spray.

Several mechanical arrangements may be employed for dividing the liquid to be evaporated, but it is preferred to place a cylindrical or other shaped casing over the pan or vessel in which the liquid is contained, and through which a current of heated air is caused to ascend. By means of a pump, chain of buckets, or other means for elevating a liquid, the liquid to be evaporated is raised to the upper part of the cylindrical or other shaped casing and poured into a pan or tray having a perforated bottom, and through the perforations in which it falls through the cylindrical casing into the vessel below, so that during the time of falling it is acted upon by the ascending heated air, and the more volatile portions are thus driven off, so that by continuing the operations herein-before set forth for a sufficient length of time the liquid may be concentrated to the desired extent. The air may be heated by forcing it through a coil of pipes, or passing it through a heated vessel or chamber.

Shipments of Sugar from the Mauritius from 1st August to the 1st of June, for the last Three Seasons.

	Crop 1869-70 Tons.	Crop 1868-69 Tons.	Crop 1867-68 Tons.
United Kingdom	36,233	20,475	49,244
France	11,155	5,179	1,655
New Zealand	3,321	2,564	—
Australia	43,648	29,902	31,707
Cape of Good Hope	1,900	732	1,654
Bombay	29,207	13,268	25,751
Other ports	1,164	678	638
	127,847	72,798	110,649

Exports from Havana and Matanzas, from January 1st to June 11th, in thousands of tons.

	1870.	1869.	1868.
Great Britain	119	88	100
United States of America	110	136	109
North Europe	7	7	10
France	30	27	26
Spain	36	27	29
South Europe	2	2	3
Other parts	5	3	5
	309	289	281
Stock in Havana and Matanzas	133	108	131

Comparison of Stocks of Raw Sugars in the Chief Markets, to end of May, in Thousands of Tons.

	1870.	1869.
31st January	442	410
28th February	441	380
31st March	465	366
30th April	502	398
31st May	499	440

Consumption of Sugar in Europe and in the United States, in thousands of tons, for the years ending May 31st.

	1870.	1869.
Europe	1326	1217
United States	440	401
	1766	1618

Stocks of Raw Sugar in the Chief Markets of the World, in thousands of tons, to the end of May.

	1870.	1869.
United Kingdom	113	87
France	77	70
Holland	50	50
Zollverein	7	16
United States	126	122
Havanna & Matanzas to 3 June	126	96
Total	499	440

This Table in last month's issue, by mistake included refined sugars instead of *raw* sugars only.

SUGAR STATISTICS—GREAT BRITAIN.

To 16th July, 1870 and 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	33	4	4	15	56	33	56	10	6	26	99	98	32	6	4	12	54	97
British East India	12	1	..	..	13	8	6	..	..	..	6	10	8	3	..	..	11	10
Mauritius	6	1	..	1	9	4	12	2	7	5	26	16	9	1	9	4	23	19
Cuba	6	5	5	17	33	23	7	13	20	53	94	53	11	12	16	42	80	51
Porto Rico, &c. ..	4	7	..	..	12	3	5	16	..	3	24	7	3	10	..	3	17	8
Manilla & Java ..	34	9	1	1	45	48	14	9	3	3	29	34	15	7	3	4	29	25
Brazil	..	20	..	6	27	16	1	35	3	14	52	42	1	22	4	10	36	47
Beetroot, &c.	2	..	..	1	4	2	15	6	3	14	38	23	15	7	3	17	42	25
Total, 1870 ..	98	49	9	41	198	137	116	91	43	117	367	282	93	67	39	91	291	282
Total, 1869 ..	78	27	8	24	Increase61		107	51	39	84	Increase85		101	61	35	85	Increase 9	

STATE AND PROSPECTS OF THE SUGAR MARKET.

At the beginning of last month all descriptions of sugar were difficult of sale, the stocks being so enormous and the deliveries only slowly increasing; but towards the middle of the month there was more demand, especially for the better class of refining muscovados, and the market generally was decidedly firmer. But in consequence of the unexpected outbreak of war between France and Germany a panic ensued in most branches of business, which of course affected the sugar market, causing the almost total cessation of business, but the prices of sugars have been very slightly altered, indeed a war between two countries which together produce more than half the beet sugar of the continent, is, if continued beyond a few months, scarcely likely to *depress* the sugar market.

The imports continue to increase and at the four ports are now 85,000 tons in excess of the same period of last year, whilst the stocks show more than 60,000 tons increase to the same date. On the other hand the deliveries have materially increased during last month and are now more than 9000 tons above those of the same period in 1869.

Prices of nearly all sorts of sugar are about the same as last month, if there is any decline it is only on low descriptions, and is very trifling. No. 12 Havanna afloat is valued at 27s. to 27s. 3d., which is about 9d. to 1s. per cwt. under last year's prices, and 1s. to 1s. 3d. above those of 1868. Common refined lump is worth 39s. 6d. to 40s. in London.

The apprehensions of partial failure in next season's beet sugar crop have passed away, and there is now a probability of a fair yield from a larger acreage sown than last year. Of cane sugar there are no unfavourable accounts from any part, the stocks are still above the average in Cuba, and in the United States. The most hopeful feature for the future is the increasing deliveries in the United Kingdom, which may prove to denote increased consumption of sugar in the country.

THE
SUGAR CANE.

REGISTERED FOR TRANSMISSION ABROAD.

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☞ The writers alone are responsible for their statements.

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ON THE VARIOUS QUALITIES OF SUGAR PRODUCED IN CUBA AND THE DIFFERENT MODES OF MANUFACTURE.

BY EDWARD BEANES, F.C.S., ASSOC. INST. C.E., M.R.I.

(Continued from page 424.*)*

THE common battery is a very inconvenient form of apparatus and is very defective in many respects, the continual skimming requiring a great deal of attention, and the baling of the juice from one vessel to the other is laborious; but the principal objection to the battery is the caramelisation which takes place in the last copper. This is obviated by the use of the vacuum pan as a strike pan.

Planters are generally aware of the great amount of sugar that is converted into caramel where the concentration is finished in the common battery, and many have incurred the expense of a vacuum pan under the impression that nothing further was necessary to produce a first-class sugar. These hopes, however, in most cases have not been realised, and many have experienced the mortification of finding their new product inferior in some respects to that formerly made. The cause of this result is owing to the new product containing a larger quantity of scum than the other. While the concentration to sugar-point is going on in the common battery, there is not only a long time allowed for skimming before

it comes to the last copper, but the skimming goes on until the syrup almost arrives at the sugar-point: it is, therefore, comparatively free from impurities. Whereas, when it is baled out of the last copper at the density of from 25° to 27° Baumè to be concentrated to sugar-point in the vacuum pan, it is not sufficiently cleansed, and as it cannot be further skimmed in the vacuum pan the scum is boiled up with the syrup and the result is a dark greyish sugar. However much it may be washed by the process of claying it will never become white, because the particles of scum are retained between the plates of the crystals.

This defect may be remedied by defecating the juice, either by steam or open fire, before it is passed into the coppers. By this means, as already explained, the greater portion of the scum is left in the defecator and comparatively little skimming is required. When the syrup arrives at the density of 30° Baumè, it should either be run into precipitators, so that the floating impurities may settle to the bottom and the clear syrup be drawn into the vacuum pan; or, otherwise, it should be passed through bag filters until it runs absolutely transparent.

The presence of gluten in the juice gives a great deal of trouble to the sugar makers. On some of the rich soils the juice contains so much of it as to render the manufacture of sugar on the old plan very difficult, on account of its solubility both in alkalies and in the acids of the juice. The gluten is rendered insoluble by the sulphites, and thus good sugars may be made even in unfavourable localities; but where animal charcoal is used, the sulphites (bisulphite of lime being generally used) are not to be recommended, as the sulphite of lime in the syrup becomes deposited in the animal black in the form of sulphate of lime, which is difficult to be got rid of.

It is found that generally where animal charcoal is used for the first time on a plantation, during the first crop, and while the charcoal is comparatively new and has not lost its power of removing lime, the sugar obtained is excellent; but when the charcoal becomes saturated with lime it no longer acts as a

decolorizing agent, and only serves the purpose of a mechanical filter. The sugar in the latter case is always better than that obtained by the common battery, from the circumstance that the filtration and consequent cleansing is better, and the sugar, moreover, is evaporated in vacuó; but still the result is far from what it might be.

I had long felt the want of some simple process for either removing the lime from the juice before it passed through the animal charcoal, or the removal of it from the charcoal itself afterwards. I instituted numerous experiments with the view of accomplishing the latter, but finding I did not succeed without attacking the bone itself, I gave it up for a time, and turned my attention to removing the lime from the juice. I succeeded in this by using *phosphate of ammonia:* a solution of the latter substance was added to the juice after being defecated by monosulphite of lime. The phosphate of ammonia rendered the lime insoluble. The juice was afterwards passed through bag filters, which retained the basic phosphate of lime. This process was adopted in Cuba on the plantation of Don Juan Poey, one of the most enlightened and scientific planters of the island, who published an account of it in the Diario de la Marina, of Havana, on the 13th of January, 1864. But I still had hopes of obtaining the same result by a cheaper method, and therefore again turned my attention to the removal of the lime from the bone black, and eventually succeeded in doing so, and at almost a nominal cost. I found that when *dry* bone black was allowed to absorb *dry* hydrochloric acid gas, or *dry* chlorine, the gas converted the lime into chloride of calcium without acting on the structure of the bone itself in the slightest degree. The chloride of calcium, being a very soluble salt, is easily removed by washing and the char is freed from lime. Charcoal thus treated for colonial sugar manufacture is superior to new charcoal, as it is free from sulphide of ammonium.

The following observations on the vacuum pan are equally applicable whether it is used by the planter or by the sugar refiner. Many sugar refiners as well as sugar planters are under the impres-

sion that so long as they get a good vacuum and at the same time the usual daily quantity of sugar, nothing further can be obtained, and they pay but little or no attention to the *degree of heat* of the steam used for evaporation. I think the latter of the greatest importance, inasmuch as the colorization of the syrup depends to a great extent on the *heat of the evaporating worm*. They take every possible precaution to obtain the syrup as free from colour as is possible, and they should be equally as careful to avoid giving colour to it again in the process of concentration. Other things being equal, the amount of colour produced by the process of concentration is in direct ratio to the degree of heat *of the evaporating steam worm with which the syrup is in contact.*

By augmenting the evaporating surface, a much lower temperature of steam may be used without diminishing the evaporative power of the pan.

With the present shape of vacuum pan, in general use, it is perhaps difficult, if not impossible, to accomplish; but by altering the shape any amount of evaporating surface can be obtained, by which it would be just as easy to concentrate with steam at 212° Faht. as at present with a temperature of 260° Faht.

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THE SUGAR CANE INDUSTRY IN ANTIGUA.

(Continued from page 458.)

BURNING lime-stone under the battery is seldom satisfactory, the lime often slackens with the megass, and is hardly ever really fit for use. Temper lime imported in jars or tight puncheons will give a much better separation, and will be found in the end most economical. As soon then as sufficient lime has been added, and a juice perfect in color and transparency obtained, heat must be carried to *absolute cracking, not under;* but as this is so near the boiling point, and requires such nicety, watchfulness, and attention to prevent ebullition, it acts as a temptation to the negligent not to

perfect this most important part of the process, and the result is of course, defective clarification. The juice after being fully simmered should stand at least thirty minutes before it is drawn on the battery, to which it must be made to run slower and slower in proportion as the quantity lessens—the eye and hand ready at a moment to shut off the first impinging particles of sediment. In Demerara I believe the juice is brought to the boiling point before the clarifying agents are added, and after a few minutes brisk ebullition drawn into subsiding vessels where all the floculent matter falls to the bottom, and the clear fluid flows from the surface through a vulcanised india-rubber tube fastened to a float—there is less loss occasioned by this method, but it entails the necessity of ensuring proper descent from the different vessels, and much time lost waiting for complete subsidence.

ON THE BATTERY.—The liquor directly it has ceased running from the clarifier into the first boiler should be allowed to remain as motionless as possible until it again comes to the simmer, when the skimmer rapidly, and lightly used, will free it from any remnants of scum, if however, the contents of the first boiler be allowed to break up before the skimming operation is complete, the floculent and solid matters become mixed up and difficult to separate in the after process. To make really fair sugar the battery should be entirely of copper and leaded; with the introduction of cast-iron pans and tiles Antigua lost her name for making muscovado, and indeed it is only necessary to watch the evaporation as it goes on in these cheap and nasty substitutes, to understand how next to impossible it must be turn out anything like a bright strike. When kept quite full the liquor boils upon, and between the joints of mason-work, and if the contents reach only to the rim of the boiler we then have a constant char, and numberless brown streaks can be seen trickling down in the form of burnt sugar, every moment adds a darker shade to the liquor, and as concentration progresses, the evil increases. The marked discolorization of liquor that has remained in these pans overnight proves also the deleterious action of iron upon cane juice, and is quite an argument for emptying them

after the day's work is complete, particularly as they do not like copper sustain any injury from heat. It is sometimes amusing to watch the determination with which the old hands from the force of habit endeavour to wet round these pans, forgetting in their zeal that although such manipulation was necessary in the copper battery it is here absolutely injurious, sprinkling as it does broadcast little streams that trickle down as pure caramel. With regard to the size of the boilers there is a great diversity of opinion; some contend for wide shallow vessels having a large extent of evaporating surface, and this would appear reasonable when the saving of fuel is taken into consideration, and there are again other planters who prefer a medium battery. All agree however in the superiority of a small tache, as this enables the strikes to be taken off more rapidly, and the sugar is consequently a shorter time subject to the action of fire at that particular stage of concentration when it is so likely to suffer. The battery, whatever size, must however be kept full, and the skimmings taken off as fast as they rise, but as the liquor ought to be quite free from scum by the time it reaches the second tache the wooden brush is only necessary in this vessel, where a large quantity of clean, sweet liquor should be kept to ensure the immediate supply of the tache, unless however the liquor be in sufficient quantity when boiling to float on a line with the saddle it cannot be properly brushed, nor can it be considered really clean.

PURE LIME WATER is with some a favourite application during evaporation and granulation; but it is seldom called for if a sufficiency of lime has been dealt out in clarifying. Lime in any shape or form can hardly be used with impunity on our battery after the liquor leaves the first boiler, and should the nearly concentrated syrup show a deficiency, in nine cases out of ten the time for supplying it has passed.

THE TACHE should be always of copper, kept bright and capable of holding from seventy to one hundred gallons, but as it can be made to contain nearly double by allowing it to be filled above the rim, to ensure really practically a small tache we must be watchful

of its supply. From various causes particularly in dry seasons, the syrup as it increases in density begins to char, and careful as we may have been during every step of our operations and however fair and promising in appearance up to this point; the sugar suddenly becomes dark and quickly discoloured, every moment that it remains on the fire after this change adds considerably to the injury, and as with our present mode of manufacture we can hardly expect any other result, it would be advisable just at this particular stage, and before any damage has arisen from the action of the flame to resort at once either to the Aspinall or Bour pan to complete concentration, or be content with the system common in Barbadoes under similar circumstances, of striking low, in conjunction with the use of the oscillator and the addition of lime water to the coolers. But as there are few estates in this island that can boast of such appliances as I have named, and fewer still that would be satisfied to boil low, the result is a brown or black undrained mass called sugar. The sacrifice of quantity to quality has long gone out of fashion, and our economical eyes would be very properly shocked at the appearance of syrup on the coolers, or indeed anything under perfect solidity. It is not necessary to enter into the absurdity of expecting as a rule with our present battery either good colour or grain from very high boiled, cold potted sugar, particularly in an island where it is nearly always dry during the manufacturing season, and when the canes suffer so regularly from drought. The fine products turned out in this Island in the days of Messrs. Salmon and Freeland were all low boiled, not potted sugars, in fact so low as often to show inches of ungranulated syrup in the coolers, and in the staunchions, and molasses cistern large deposits of crystallized sugar—but those gentlemen knew a fair large grain could only be supplied at the expense of quantity, and they also knew that it was not then as now—"How many hogsheads have you shipped?"—but rather—"What price did your sugars bring?"—If we were content to make the same sacrifices we might perhaps be as successful even with our present batteries, but science has done quite enough to

enable us to perfect, without loss, our concentration by steam, and to turn out both quantity and quality. It becomes then a question, are we prepared for the necessary outlay to ensure a remunerative price for our sugars? or must we be content to become literally planters or growers? depending upon capitalists setting in to establish central factories, where the introduction of scientific and modern machinery will quickly demonstrate the practicability of white crystals?—the necessary outlay does not, however, consist absolutely in vacuum pans, charcoal filters, or centrifugal power, but in the re-introduction of copper batteries, the erection of one or more Aspinal pans, or steam taches, with a separate boiler for their supply, the use of animal charcoal to decolour the syrups, and the constant use of these auxiliaries when the sugar arrives at a certain density. Potting warm is also necessary to ensure perfect and rapid drainage, very little loss will however be sustained by this being re-introduced, as with steam-boilers at hand, a sugar may be turned out from molasses quite equal, if not superior, to the generality of our shipments. While speaking of animal charcoal, it may perhaps be as well to try and dispel the erroneous ideas connected with this substance; it is not as expensive as supposed, and when I say an outlay of about sixty pounds will more than cover the first cost for a crop of two hundred hogsheads, taking re-burning into consideration, no objection really can be found to it on that account, nor can any difficulty exist in getting a syrup of 25° Baumè to run through it by gravitation alone. Animal charcoal does not only act as a decolorizing agent, it has besides some power in decomposing the various salts, and its antacid properties are unquestionable.

STRIKING, OR SKIPPING.—When the syrup has been fully evaporated and sufficiently concentrated to secure granulation it is the usual practice to slacken the fire in order that the tache may be emptied without sustaining injury, but unless this operation is most carefully conducted so as to ensure complete falling of the flame, not only the copper, but the sugar also will suffer, and however fair and bright the first portion of the strike may be the continued influence of a high

temperature will so run up and char the residue as completely to discolor the entire skip. On some estates the fire is not even slackened, but the dipper quickly lowered and an endeavour made to lift out at one operation the whole strike. In *theory* this may appear reasonable on account of the time gained, the rapidity with which the sugar is in one mass removed from the influence of the fire, and the certainty of obtaining a uniform quality; but *practically*, it is (as I have expressed it above) only an endeavour to take up at one operation the whole strike, for however accurately the dipper may be adapted it invariably leaves behind a portion of sugar sufficient (with the immediately increased temperature consequent upon the lessened quantity) to discolor the next concentration; and again, if even we could secure the most perfect adaptation between dipper and tache as well as the most rapid refilling or charging, the mere momentary contact of the two vessels undoubtedly does harm. With the immovable tache in use here, wherein the sugar cannot be at once raised up or discharged, it is better to be quite sure that the flame is entirely subdued before any portion is taken from it, and the use then of the large ladle instead of the dipper is to be preferred, because the process is necessarily slower, and at all times slow enough to secure in every case a great reduction of temperature long before the operation can be completed; the risk of a burnt tache or the adhesion of caramel scales is also much lessened. In the present mode of concentration even with some care and precaution, sugar is at all times liable to adhere to the sides and bottom of the tache. These adhesions when once formed are in themselves sufficient cause of a similar and further deposit, and as their presence must also deprive the heated metal of the protecting influence of the syrup, it is advisable immediately they are noticed, and the tache emptied to throw some unctuous substance, such as lard, butter, or tallow upon the burnt parts and then even at the loss of time endeavour to restore a thoroughly brightened surface before the work is resumed. It has become the fashion of late to be satisfied with the spasmodic efforts consequent upon attempting to take off these

burnt scales by means of a sharpened tool at the end of a stick or handle, and although admitting the almost impossibility of inducing anyone in these enlightened days to take upon himself the salamandrine character so necessary to perform this work thoroughly, yet so great is the present and prospective injury by allowing this nucleus of damage to remain that it would be preferable even at the sacrifice of time to wait for the necessary manipulations rather than consent to the use of sharpened instruments. Let anyone consider the harm done by digging at a heated surface of copper, the numberless projections and indentations produced thereby and the consequent roughening; they will at once understand then how this worse than useless operation each time performed leaves the surface in a more favourable position for the recurrence of the injury, by raising up points and irregularities to which the sugar must at sometime adhere. An instance occurred not long since where a tache was condemned as an "unconquerable scorcher," some attributed the peculiarity to the casting, some to the shape, or to the metal, and others thought that perhaps it was not really worse than its neighbours; on inspecting the inside and ascertaining that it was purchased second-hand the case was as clear as noonday, and the interior as rough as a grater; in serving its time this tache had probably been most studiously and determinately dug at, and after thus being rendered useless it was quietly deposited in the lumber store as old copper.

Coolers—holding from six to eight hogsheads and even more have been also a late introduction, and contrast strangely with the similar old fashioned vessels of one or two hogshead capacity; those who looked upon their depth as an objection have found that from the extent of cooling surface each strike granulates more readily than in the smaller boxes; they may really be considered well adapted for low boiling and although a novelty, form no part of the cause for low brown.

Hogsheads—Should be made from raw staves of good heavy quality, the price of American shooks sometimes acts as a temptation for using these poor substitutes, but our forefathers remembered

the tare when they willingly consented and reckoned for a crop two sets of truss hoops, determined neither to allow the stave to be chopped away to a lath, or its strength impaired for the want of shape. It is a remarkable fact, worth observation, that where-ever the sugar touches the stave in a *shook* hogshead it rapidly deliquesces, and this, together with the absence of shape, strength and weight, is sufficient evidence in favour of the newly made cask. The peculiar action exerted by the shook staves upon sugar is to be accounted for by the steaming they have undergone, which charges the pores with water in sufficient quantity to dissolve any salt that they may come in contact with. By the recent change of the period for assessing the duties on sugar, would it not be as well to secure a properly cured package, either by filling up at one operation, boring the sides and bottoms fully, or in the removal of the wet footings, and the introduction of centrifugal power?

Many substances, both vegetable and mineral, have been used at different times for clarifying, as well as granulating cane juice, and lately we have heard great praise bestowed upon alum alone, and alum in combination with magnesia, as giving body and brightness. All these means, however, when in the hands of the ignorant are only applied blindfold. A proper chemical education being necessary to determine cause and effect, and to follow out certain points that could never be noticed by the uninitiated.

If cane juice had had the amount of scientific thought bestowed upon it that the beet has attracted, the latter could never have become so formidable a rival, but remaining in its obscurity would have been still, no doubt, used only in its legitimate sphere as a wholesome and proper food for cattle.

F.

THE MANUFACTURE OF SUGAR.

(From "The Engineer.")

If the purport of what has gone before on the manufacture of sugar has been rightly apprehended, the conclusion will be inevitable that, if full scope were only given to manufacturing appliances, refining, defined as a second purifying operation, should not be necessary at all. No doubt exists, either in the minds of chemists or practical sugar growers, that the object of their solicitude exists in the cane ready formed, and is only metamorphosed to yellow or otherwise coloured sugar by rough treatment had recourse to in getting it out. At a time when the nature of sugar was not well understood, the production of brown or yellow sugar by the colonist was deemed a necessity, and refining to give whiteness indispensable. These are prejudices resting on no foundation, and they have been many years cleared away. There can be no doubt now that it is altogether chemically better to effect the complete purification of sugar-cane juice to white sugar than to crystallise it roughly in a coloured state, preparatory to a second refining operation. Still we must not be too hard on the colonial growers of sugar-cane. Their case presents an aggregate of many difficulties, of which the following are chief:—The sugar manufacture, carried to the extent of refining or inducing a state of perfect whiteness, is an exceedingly delicate art. It needs complex machinery and skilled labour, both chemical and mechanical; it needs abundant water, fuel, and bone-black. Further, even supposing white loaves actually made, the point has to be considered whether they would easily bear storage and transport in holds of ships, for if not, if their beauty should be in any considerable degree impaired, the scheme of colonial refining would not be successful. Of course this objection does not apply to the sort of white sugar known in commerce as crushed lump, mere disintegrated granular crystals, but this form of sugar is not universally appreciated. Although it has all the saccharine qualities of lump sugar, yet it does not look so elegant on the table—does not, as one may

say, furnish so well. Lastly, in palliation of what some have deemed a neglect of the sugar colonialists, the circumstance has to be borne in mind that embarassing fiscal restrictions have been laid upon them, the result of protective legislation made on behalf of the home refining interest—one only next to the brewing interest as regards political influence.

Although no functional line of demarcation can be established between the colonial process of sugar extraction and the home or refinery process, yet, practically, refining is individualised by the three following particulars, viz., (1) operations conducted on strong saccharine solutions; (2) vacuum boiling; (3) charcoal—or, rather, bone-black—filtration. With regard to the two latter, it is true they occasionally enter into colonial operations. However there the use of them is exceptional, they bear the refinery impress, and to the mind of those who are acquainted with the sugar manufacture under all its phases, they necessarily associate themselves with ideas of refining.

If principles be considered, the cause will be apparent that determines the use of strong saccharine solutions in refineries. The stronger the liquid the less evaporation needed to effect crystallization; hence proportionate diminution of fuel, of time, of destruction to the sugar. Another circumstance has to be noted as pointing to thick solutions, and it is the following:—The decolorizing effect of bone-black—wrongly called animal charcoal—does not take place equally well on sugar solutions of whatsoever density. The density of 26° Baumè is about that which best accords with the agency of bone-black. Above or below this grade the effect of bone-black diminishes; nevertheless a preponderance of other circumstances generally induces the refiner to establish a solution of higher specific gravity than 26° Baumè. He seldom works at less than 33° Baumè, corresponding to a percentage of sugar, which a table previously given will make known.

Necessarily the first operation in refining is to effect solution of the sugar to be acted upon; and this suggests a few remarks on the best sort of sugar to undergo the operation. Although refiners can

work on any sample of sugar—though in two or more samples the actual percentage amount of sugar be the same—yet it does not thence follow they shall refine equally well. Some tints yield themselves up to bone-black more readily than others: this, experience alone can indicate; but, generally speaking, it may be said that grey tints are the most intractable. However, of whatever sample the raw material may be, it has first to be dissolved by a process technically known as that of "blowing-up," the reason for which designation will become apparent as we proceed. Blowing-up is effected in what is called a blow-up pan, a vessel of iron or copper, having a false bottom or grating of pipes for conveyance of steam. The blow-up pan is charged in this fashion:—Upon the floor the sugar to be dissolved is turned out, then shovelled into the pan. Water is now let in, and the steam laid on. Necessarily, as the steam is immediately condensed, imparting its heat to the water, a great noise occurs, a roaring or blowing sound; hence comes the designation of blowing-up. Apportionment of sugar and water is not regulated by weighing in the sugar, or measuring in the water, but by the test of specific gravity.

Steam is allowed to enter until the contents of the pan approach boiling, but do not actually boil; and now—sometimes, not always, but still more usual than not—a portion of bullocks' blood is added and stirred about, the object being that the blood albumen, in coagulating, shall entangle, and bring to the surface in a crust a portion of the impurities which colonial sugar always has mingled with its crystals. As the scum rises it is lifted away by a skimmer, and put aside for conveyance to the scum press. For some reason, sugar refiners are averse to acknowledge the use of blood. Nevertheless the practice is almost universal, and not on any sanitary grounds objectionable. Publicans, when speaking amongst themselves about water dilution of their spirits, are not allowed to call the diluent water under penalty of a fine; they call it liquor: equally fastidious are sugar refiners to speak of the blood they employ as "spice."

When the blow-up is effected, when, that is to say, a solution

of proper density, has been effected, heated to the proper temperature, and scum has ceased to rise in quantity sufficient to admit of skimming, a tap being turned, the solution is run off into the bag-filter tray, communicating by screw nozzles with the bag-filters, the nature and arrangement of which, for effecting bag filtration, next claims our attention. If we suppose a bolster-case made of twilled calico, instead of the usual material, and sewn up at one end, we shall have the exact similitude of a bag-filter. The twilled calico used in making these bags is specially manufactured for the purpose in the round. If now we assume one of these bags to be drawn through a bottomless canvas sheath of open material, and much smaller in diameter than itself, if we assume the projecting or open end of the filter-bag to be firmly tied to a metallic nozzle, and lastly the screw end of the nozzle screwed into a hole in the bottom of the filter tray, the arrangement, as regards any one filter-bag and fittings, will be complete.

The filter-bag, sheath, and bell is an arrangement which evidently affords large filtration surface in a small space, which is the end proposed. One filter tray has many filter-bags attached to it; the entire complement of bags hang in an iron cupboard, which, when the door is closed, becomes a steam chest, steam being admitted to keep the filtering tissue open, thus facilitating the process. If a portion of solution reserved from the blow-up pan be taken and compared with a portion taken from the bag-filter exit, a marked difference will be observed between the two; not in tint, bnt in clearness. The sample taken from the blow-up pan is always more or less turbid, whereas the liquor as it comes from the filter-bags is, or ought to be, clear and transparent. If it come short in these respects, then, no matter how light it may be in colour, the resulting sugar will always be more or less grey.

From the filter-bags the liquor passes to the bone-black filter, which must now be described. The bone-black used in sugar refining is inappropriately called animal charcoal, seeing that some 70 per cent of it is made up of carbonate and phospate of lime, the remaining portion only being charcoal. The precise *rationale*

of bone-black in effecting decoloration of certain solutions is not known. Chemists refer the effect to "catalysis," a word which, as often as it occurs, may be taken to signify that chemists are ignorant of what takes place in any result which catalysis is said to determine. The practice of different refineries differs as to the use of bone-black. In some establishments the charcoal filters are leaden rectangular tanks; in others (and mostly) they are wrought iron cylinders, very much like steamboat funnels in build, varying as to diameter and length according to the size of the refinery. Whatever the shape of the charcoal filter may be, one general mode of packing it prevails, which is the following:—Over the real bottom a perforated false bottom is laid, and over this two or three thicknesses of flannel, very thick, and epecially made for sugar refiners' purposes. Upon this the bone-black — granules, not powder—is thrown, and evenly arranged by a workman with a straight edge. In this way the packing is conducted until the filter leaves room enough above the charcoal level to hold the full volume of liquor to be presently turned upon it. From the bag-filters the liquor runs to the charcoal filters, but with certain precautions to avoid disturbance, which would happen were the fluid permitted to fall upon the level of the charcoal direct. To avoid disturbance some workmen put a pot or any vessel upon the charcoal level, and allow the liquor to fall *into*, and eventually of course flow *over*, the pot. A still safer plan is to furnish the charcoal level with a blanket layer, as below, using the pot in addition. It may be wondered, perhaps, that such minute precautions are necessarily taken on a level of bone-black, the usual thickness of which may be some 10ft. or 12ft., or even more. Practically, however, these minute precautions are found necessary to obviate the passage of charcoal dust into the final or boiling tank, a result which would impart a tinge of grey to the sugar.

When shallow filter tanks are used it is necessary to keep the solution in contact with the charcoal for a time longer than that which would be occupied in mere percolation; but where elongated filters are concerned, the time of percolation is usually long

enough to admit of full decolorizing effect. Still the operation would be ruined were the exit cock to be turned on to the full, so that the fluid might emerge in a gush. The cock should be at first very slightly open—just open enough to give egress to air which the bone-black interstices lock up. It should then be turned on fuller and fuller very carefully. If the need of boiling is not pressing, it is always well to give the filtration all licence of time possible. Only loss of time can result from a small filter stream : grey sugar may result from a large one.

With regard to colour, refinery sugar solutions as they come from the bag-filters may be compared to claret; when, however, they first come from a charcoal filter—new and in good order—the same solutions are absolutely colourless. Their refractive index is very high, for which reason they are brilliant as viewed by refracted light. Judged as to tint they give the impression of absolute purity; but when smell is brought to bear they evolve the characteristic faint odour of blood, whenever (as mostly) blood has been used in the blow-up pan. This fact is undoubted, and the more worthy of being insisted upon on account of a certain popular belief that all the blood—in other words every constituent of the blood—is removed by charcoal filtration. True the colouring matter of blood can be removed by animal charcoal when freshly burned and in good condition, but the odorous matter never is—*cannot* be removed by this or any other known treatment, from the liquor or dissolved sugar. Its presence is confirmed beyond all doubt by the sense of smell, the odorous principle of blood being very distinctive. When the liquor after boiling forms crystals, and the semi-solid mass is potted and drained, as will be hereafter described in the proper place, then the odorous matter passes away in the drainage, to become treacle.

Reverting to bone-black filtration, it must be stated that although the first liquor which comes through, and also that which passes for some time afterwards, is colourless as so much pure water would be, nevertheless, succeeding portions grow darker and darker. The time to elapse before tint becomes manifest depends on such an aggregate of variable circumstances, that no precise rule can be

given. The total deprivation of colour is not a matter of such great importance as a stranger to sugar refining might be prone to imagine. Perfect transparency, however dark the tint is the indication a refiner especially heeds. However colourless the liquor may be, it is sure to acquire colour during the future process of boiling; which acquisition can only be got rid of by a compound process of drainage and washing, technically known as *draining*, *claying*, and *liquoring*. If the percolated liquor be dull—when examined by refracted light, still worse if it be milky or opalescent—these indications are a sign that mechanical particles contaminate the liquor; a sort of impurity that results in the production of grey sugar. The causes that give rise to milky, dull, or opalescent liquor are various—some evident, others ill understood. One certain cause—though the *rationale* of it seems not to have been traced—is intermittent or irregular supply of liquor to the charcoal cistern. What we refer to will be illustrated by the following case, one, however, not to be assumed possible in any well-ordered establishment:—A certain complement of liquor, as it passes from the filter-bags, is turned on to the charcoal cistern, whence it percolates down through the bone-black charge in time, leaving the surface of the bone-black, so far as visible liquor is concerned. Necessarily the bone-black surface becomes more or less dry; and if now upon this bared surface a second charge of liquor be turned, the filtration process will, from that point of malprasis onwards, be disorganised. However bright up to that time the filtrate might have been, opalescence will make itself manifest.

We arrive now at a stage of the process when description-writing falls short in capability to represent the exigencies of practice. A writer, restricted by the nature of his case to one description at a time, fails to convey an idea of operations that are co-existent. He is obliged to make descriptions consecutive, of operations that are really simultaneous. In the present case we must not forget that the filter-bags will have to be seen to. If they have done the work required of them, the sooner they go to the scum house the better. Again, the charcoal tank needs attention. If the charge of bone-black have done its work, the sooner it is disposed of the

better. Both scum pressing and charcoal filter clearing are important operations—the second very important. We shall have to revert to both hereafter; but, meantime, we will follow the portion of liquor which has already been charcoal filtered into the vacuum pan. In every operation on sugar, whether of colonial treatment or of home refining, one rule has to be prominently regarded, and the value of that rule is so paramount that the term *golden* may be, without violent metaphor, applied. The rule is the following: —Never let sugar in solution lie above one minute longer than imperative circumstances necessitate. Change it to the solid state with all practicable dispatch, knowing that sugar solutions are subject, not to one sort of fermentation alone, but to many; remembering that some of these fermentive changes depend on conditions that cannot always be traced, and which often, when traceable, can rarely be averted. A thunderstorm, for instance, may induce the lactic fermentation in a sugar solution that was but just now unaffected. A sugar manufacturer, be he colonialist, be he refiner, can never depend on realising the complement of sugar made known to exist in a saccharine fluid by the evidence of specific gravity, until he *has* realised it, which can only be said to have been accomplised when crystalline or solid sugar has been got.

The practice of vacuum boiling is guarded as a great secret by those who have to conduct it; but the theory of vacuum boiling is simple and easy, and the practice not difficult to one who has any sort of acquaintance with mechanism. At what particular degree of heat any given solution shall boil is determined by pressure, other things being constant. We have already seen the destructive effect of heat on sugar. The vacuum pan enables the operator to work at a lower degree of heat than he otherwise could, and hence to lessen the destructive effect of boiling. It would be waste of time and space to describe the construction of a vacuum pan in this journal. Assuming it known, we shall proceed to describe the process of vacuum boiling according to the most approved method. The liquor to be boiled is usually got into the pan by suction, that is to say a feed-pipe, in communication with a tank, gives entrance to the liquor when a partial vacuum has been established. The plan of

boiling we prefer for good, and moderately good liquor, is the following :—Knowing how much the total working capacity of the pan is, we get in one-third of that amount, and then begin to evaporate until small crystals have formed—an operation technically called getting in the grain. This accomplished we let the remaining part of the complement ooze in, so as just to keep pace with evaporation, but not exceed it. By proceeding thus the grain or crystal, once formed, is never dissolved out. Thus we continue until the boiling has been carried far enough, when the whole charge is suddenly let drop into a jacketted pan called the heater through a circular ground valve orifice. In summarising the operation of vacuum boiling, those details which are the most difficult part of the business have been left unheeded. How are we to know that the process goes favourably on? How are we to discover the presence of crystals in a closed vessel? Let us explain. First, every vacuum pan has a round glass pane—the sight-hole through which the general appearance of things inside may be noted. Every vacuum pan again has a barometer and thermometer, by the combined indications of which a pretty correct notion may be formed of passing changes. A careful operator, moreover, will, from time to time, lay his hand upon the condenser and learn by the sense of touch, judging by temperature, whether condensation is proceeding well. The crucical test, however, is furnished by taking a proof, accomplished by the proof-stick. This instrument, concerning which such a mystery is made, is only an ingenious but very obvious contrivance for getting out a small sample of sugar from a closed vessel without admitting atmospheric air, and thus destroying the vacuum. To use the proof stick first look for a small round hole near the transverse handle—that hole being a mere guide-mark, comparable to the notches by reference to which printers set up their type. Having found the hole, hold the stick in such manner that it (the hole) may face downward. In this position thrust the stick quite down to the bottom of the sheath. Next make a half turn by rotating the thumb outward. This causes the hole to look up, and bring a small spoon-like cavity at the further end of the proof stick to coincide with an opening into

the pan, whereby a sample of sugar gets into the spoon. If the proof stick were to be withdrawn in this position, we should get our sample of sugar for examination indeed, but air would rush in, and the vacuum would be destroyed. The result is obviated by the following movements: We lift the guide-hole looking upwards; we turn it down—which closes connection with the pan—withdraw it about six inches; then, with a certain degree of rapidity give a half turn, whereby the guide-hole looks upwards once more. In this position it is withdrawn, and the state of granulation examined by the finger and thumb. Sugar grains, when they have acquired a certain size, can easily be felt, but they can be seen even before if a string of syrup be drawn out between thumb and finger. In conducting this operation it is usual to examine the thread by the light of a lamp or candle held in front of a black screen. Though a considerable degree of crystalisation is effected during actual vacuum boiling, yet the evaporated syrup is not crystalised sufficiently for potting at once. Being turned into a vessel called the heater (in some refineries, curiously enough, the cooler), it is heated up to a degree more or less high, according as, in the operator's judgment, the nature of the sugar requires. It is then taken out and carried away to moulds, standing each on its apex, and the small hole in the apex of each mould stopped with a plugget of brown paper. These moulds having got cold, the pluggets are removed, so that drainage can take place. Next, the face of each partially-formed sugar loaf is cut off, mixed with water to the consistence of mortar, and then replaced. This operation is called claying. Originally actual clay was used. After claying, the process called liquoring is established, which consists in pouring upon the clayed faces a portion of pure and saturated sugar solution, which, percolating through, drives all soluble coloured matters down before it. This stage arrived at, it only now remains either to knock off, or else turn away, the apices, to paper the lumps or loaves, and dry them by storing. It would be altogether impossible in an article like this to particularise all the collateral operations of syrup boiling, scum pressing, or charcoal burning; neither was that our intention on setting out. What we designed was to pre-

sent such a sketch of home sugar refining as should enable a colonial sugar producer—one familiar with sugar under one aspect, but unfimiliar with refining—to judge in how far refining operations may suit his own case. We call the especial attention of such a one to this. The vacuum pan, although the very best instrument for economising the loss on sugar evaporation, can only be successfully used in connection with a pure, well-defecated jüice. Being a closed instrument, whatever scum forms must remain, and get incorporated with the sugar.

ON ANIMAL CHARCOAL,

PARTICULARLY IN RELATION TO ITS USE IN SUGAR REFINING.

By Dr. Wallace, F.R.S.E., Glasgow.

Being the Substance of a Lecture Delivered before the Members of the Philosophical Society of Glasgow. Revised by the Author, for Publication in "The Sugar Cane."

Animal charcoal is made by heating bones in retorts until the organic substances they contain are decomposed into volatile matters and carbon, the latter remaining mixed with the mineral constituents of the bones.

The carbonization is effected in cast-iron cylinders of about 18 inches diameter and 10 feet long; but the form and size may be varied at pleasure. The time occupied varies also according to circumstances; but twelve hours is a common length of time, and generally makes better charcoal than six hours, even although the heat in the latter case is much stronger. The retorts are kept going day and night as long as they are fit for use. The manufacture in many respects resembles that of coal gas; and there are formed, as in that process, gases and liquid substances, while a solid remains behind containing the mineral matter mixed with carbon.

The bones, after being charred, are crushed between rollers, and the dust removed, when the charcoal is ready for use. The quality

of the char varies a little with the description of bones employed and the care taken in the manufacture. For example, there are what are called home-collected bones, which certainly, if hand-picked, make the best charcoal; there are South American shank bones, from the salideros of Brazil and Buenos Ayres; and there are camp bones, which are frequently dug up from old battle-fields, and must be a mixture of all sorts, but chiefly cattle and horses. Many of these bones bear evidence of having been buried for a considerable time; and it is quite easy to distinguish the charcoal made from them from that prepared from recent or "home-collected" bones. Besides these varieties, we have large shipments from Italy and Turkey, in the latter of which the bones of the camel are mixed with those of cattle, antelopes, sheep, and horses.

The composition of the best charcoal, made from home-collected bones, is something like this, *when dry* :—

Carbonaceous Matter	11
Phosphates of Lime and Magnesia	80
Carbonate of Lime	8
Sulphate of Lime	·2
Alkaline Salts	·4
Oxide of Iron	·1
Silicic Acid	·3
	100

The carbon varies a little according to the amount of boiling with water the bones have received, in order to remove grease and gelatine; but it also varies in different parts of the bone, the exterior hard part having a smaller percentage than the interior and softer portion. Hence the larger the size of the charcoal, the less the proportion of carbon present. The carbonate of lime also varies a little. Besides the above ingredients, the charcoal usually contains about 10 per cent. of water, which is thrown upon it in order to cool it, and to prevent the carbon from burning away.

The chemical analysis of charcoal presents certain difficulties, notwithstanding the apparent simplicity of its composition. This is particularly the case with regard to the carbonic acid. But I will not detain you by describing my method, as you will find one

equally good, although perhaps a little more complicated, in the second volume of Fresenius, special part.* In this process, as in my own, the carbonic acid is accurately measured. The method used by some chemists of precipitating the phosphate of lime, and then throwing down the lime in the filtrate in the usual way, gives results entirely fallacious. There is generally a trace of free lime in the charcoal; but I have never found it to be more than a minute quantity. It is best, however, before estimating the carbonic acid, to treat the finely pulverized charcoal with solution of carbonate of ammonia.

I have stated carbon to be one of the constituents of charcoal; but, although it is always called carbon, it is not strictly pure carbon, but consists partly of that element and partly of nitrogen, with a minute quantity of hydrogen. The fact that charcoal prepared from animal matters contains some nitrogen has long been known; but I do not recollect having seen any statement of the amount. I have made only a few determinations myself; but these appear to indicate that the proportion is variable, and also that, when the char is used in sugar refining, the amount constantly diminishes. Thus, in a sample of char made from home-collected bones,† I found no less than 1·55 per cent. of nitrogen out of a total of 8·5 of carbonaceous matter; and in another sample, made from foreign bones, I found 1·08 of nitrogen out of 9 of carbonaceous matter.‡ Two samples of moderately old char gave respectively ·3 and ·55 of nitrogen—the quantities of carbonaceous matter being respectively 15 and 17. I am not at present prepared to express an opinion whether this nitrogen plays

* Schiebler's method, a complete description of which will be found in the *Chemical News* for August 12th, 1870.

† These bones must have been over-boiled, and too much of the gelatine removed.

‡ The carbon in this sample, separated by dissolving in acid, gave 8·2 per cent. of nitrogen, or in 9 grs. ·74, or only about ⅔ of the total quantity of nitrogen present. In other cases the proportion of nitrogen in the separated carbon was much less. Generally, the quantity of nitrogen in new charcoal is about one-tenth part of the total carbonaceous matter.

an important part in the decolorizing action exerted by charcoal; but one thing is certain, and that is, that we know of no variety of charcoal that is really a good decolorizing agent that is not made from a highly nitrogenous substance. Wood charcoal, for instance, although eminently porous, is a very poor decolorizing agent, and is practically useless. I shall, however, reserve my remarks upon the active constituent of charcoal until I have discussed some other points. The proportion of hydrogen in well-burnt charcoal is exceedingly minute, being in one particular case (new) only ·034 per cent. The moisture in new charcoal cannot be estimated at 212°, but requires a temperature of 350° Faht. to drive it off completely.

The accurate estimation of the carbon in new charcoal cannot be made by burning it off, neither can it be effected by dissolving in acid, collecting the carbon and silica, and then burning off the carbon. The nitrogen, in the latter case, should be estimated, and also in the original charcoal, and the difference (which varies from ·1 to ·5,) added to the carbonaceous matter, as obtained by dissolving in acid.

New charcoal always contains traces of ammonia; and we cannot wonder at this when we consider that a large quantity of ammonia is given off from the bones during the calcination. The amount is usually very minute.* Frequently it exists as sulphide of ammonium, and in this case causes great damage to sugar run through it; but such accidents are entirely prevented by washing the charcoal well, and re-burning it before passing liquor over it. By this treatment the common salt is removed, together with the traces of ammonia; traces, also, of sulphide of calcium are either removed or rendered harmless. Whenever charcoal is overburned, the small quantity of sulphate of lime always present is decomposed, forming sulphide of calcium; and this always exerts an injurious action upon sugar. Such overburned charcoal gives off the odour of sulphuretted hydrogen when moistened with water,

* In a particular case I found a new charcoal to contain ·011 per cent. of ammonia.

and still more distinctly when treated with an acid. A sample of new char gave ·08 per cent. of sulphuretted hydrogen on treating with hydrochloric acid.

Again, charcoal, both new and old, retains appreciable quantities of gases which escape when cisterns containing it are filled with liquor; and these gases are frequently combustible, and, when mixed with air, explosive.

I shall now refer to some mechanical properties of animal charcoal. I have long regarded the bulk that charcoal occupies, as compared with its weight, as a property of great importance. A ton of new charcoal, when dry, fills a space of 47 to 55 cubic feet; but the same weight of old charcoal occupies a much smaller space —it may be 40, 35, 30, or even so little as 28 cubic feet; in fact, its *apparent* density, when measured dry, increases with age until it is nearly double what it was at first. But when we come to the absolute specific gravity of old and new char, we find that the difference is very slight indeed. Thus, a sample of new charcoal, occupying 50·6 cubic feet per ton, or having an apparent gravity of ·71, had a real specific gravity of 2·822; a moderately old sample, occupying 35 cubic feet per ton, or having an apparent gravity of 1·03, had a real gravity of 2·857, or only a trifle more than the new charcoal. The specific gravity of phosphate of lime in a pure state is about 3, that of carbon about 1·8 to 2, and carbonate of lime 2·7; and the gravities found correspond very closely with the calculated numbers. Now, here is a point of the utmost importance, and one to which I believe I was the first to draw the attention of sugar refiners—that charcoal diminishes rapidly in bulk by constant re-burning, while the real gravity remains practically unaltered. What are we to infer, then? Evidently this, that, by constant re-heating, the particles of charcoal become smaller, by the diminution of the pores; and hence old charcoal is less porous than new; and hence, also, the apparent gravity of char furnishes a ready and certain indication of its value for sugar-refining purposes. The mere effect of the continued application of heat is well illustrated in the following experiment:—A quantity of new char was taken, occupying 48 cubic feet per ton, and exposed to a pretty strong

heat in a covered crucible for an hour, after which the space taken up by a ton was only 43·2 cubic feet; after two hours more it was 40·8 cubic feet; after other four hours it was 38 cubic feet; and after four hours longer of a strong heat it was 35·5 cubic feet: thus losing in eleven hours as much porosity as it would by being re-burned in a sugar-house about 100 times.

It is well known to chemists that phosphate of lime or bone ash is capable of being readily fused at a high temperature, such as that of a pottery kiln, and that in fact it is largely employed in potteries for making what is called English porcelain, in which it acts the part of felspar in the best French and German porcelain; that is, it fuses, and, binding the particles of clay and flint together, makes the whole vitreous and non-permeable by liquids, while common earthenware is quite porous, unless glazed. A bone pretty strongly ignited becomes, not exactly fused, in the ordinary sense of the word, but the particles appear to agglutinate, and the bone shrinks very much in volume, retaining its shape, and is now vitreous and even translucent. When struck, it has almost the ring of a piece of metal. I have no doubt that a still higher temperature would actually fuse the bone; but I have never seen the experiment carried so far. In the case of animal charcoal, which, in re-burning, is subjected only to a moderate degree of ignition, the phosphate of lime does not fuse, but it is evidently acted upon to such an extent that its particles agglutinate, and the pores become lessened. The statements I have made regarding the apparent gravity of old and new charcoal amply prove this; but the same conclusion may be arrived at by other means. A piece of new charcoal burnt white has the dull porous fracture of chalk; but when old char is burnt it has the appearance af pieces of flint or pebbles, showing conclusively that the pores in it are either smaller or less numerous than in new charcoal. Again, if we take some new charcoal in a cistern or a funnel, and run water upon it until it refuses to retain any more, we find that it will hold a very large quantity—viz., from 80 to 100 per cent.—that is, if the charcoal is previously quite dry. But if we make the same experiment with old charcoal, we find a marked difference, the quantity

capable of being retained being only from 30 to 45 per cent. Once more, new char, if quite dry, requires about 20 per cent. of water to make it perceptibly wet, while old charcoal (two or three years in use) requires only about 5 per cent. These facts prove incontestably that the pores of old char are either smaller or less numerous than in new char; and I think it is a fair conclusion that, if we wish to retain char in an efficient state, we should burn it so as to lessen the porosity as little as possible. Indeed, it appears to me that the revivifying of charcoal by *burning* is an unfortunate necessity, and one which we may reasonably hope to overcome.

But although the action of heat is the main cause of the increase in the apparent gravity of char, it is not the only one. In most sugar-houses the proportion of carbon gradually increases; so that, beginning with a charcoal containing 9 or 10 per cent. of carbon, we have it in two or three years increasing to 14, 15, or as I have even seen it, although in an extreme case, 21 per cent. The source of this carbon is obvious enough; it is derived from the organic impurities extracted from the sugar, which in re-burning are carbonized. But this carbon is not deposited upon the surface of the charcoal, at least not exclusively, and hence the accumulation fills up the pores to a certain extent. Charcoal containing a large deposit of carbon is always more or less glazed; but the glazing depends in part, at least, upon the friction to which the char is exposed. Perfectly new char may be glazed by simple attrition of its own particles, but the process is tedious. The more carbon there is in old char, the more readily does it become glazed by attrition.

The deposit of carbon being a very great evil in sugar refining, it is obvious that if it can be prevented, a point of great importance is gained. That this can be done is certain; for in some refineries the carbon does not increase at all, and in others it speedily diminishes, so that sometimes it does not exceed 2 or 3 per cent. But when a decrease takes place, it is from a false system of treatment, — either the admission of air into the re-burning apparatus, allowing the hot char to pass through the air into the cooling boxes, or the application in the kilns of too high a tem-

perature, which causes a re-action to take place between the carbon and the elements of water, resulting in the formation of carbonic oxide gas and carburetted hydrogen. But if everything is tight, and the heat not excessive, the carbon will inevitably increase, unless we take the precaution of washing out of the charcoal, before re-burning, nearly all the organic matters which have been absorbed from the sugar liquor. This can only be done by a large expenditure of water, which should be quite boiling. Indeed, one of our most advanced sugar refiners insists that the charcoal must be *boiled with the water;* and my own experience quite bears out his assertion.

But extensive washing does more than simply remove the vegetable matters absorbed from the sugar. There are mineral matters also absorbed, not from the sugar only, but also in some cases from the water used to dissolve the sugar. In all sugars we have a certain proportion of soluble salts of potash, soda, lime, and magnesia, the total quantity being in ordinary raw cane sugars from ½ to 1 per cent.; but in beet very much more, varying, in the qualities that come here for refining purposes, from 1½ to 3 per cent., although in extreme cases it amounts to as much as 6 or 7 per cent. The highly soluble salts, such as those of potash, have no effect upon the charcoal, and only annoy the refiner by accumulating in the syrups; but sulphate of lime, a salt only very slightly soluble in water, has a very serious influence. Sulphate of lime dissolved in sugar liquor is readily absorbed by charcoal; but it may be got rid of by extensive washing, and more completely still by boiling. The power char possesses of absorbing and retaining certain substances depends very much upon circumstances. So long as the sugar solution is strong (having a gravity of 1·2 or 1·25), sulphate of lime is absorbed and retained; but whenever the washing begins, and the liquor gets weak, the sulphate of lime commences to dissolve out, so that it is no uncommon thing, in boiling down weak char washings, to obtain a plentiful crop, not of sugar, but of sulphate of lime. When the water is hard and contains much sulphate of lime, the proper washing of charcoal becomes almost, if not quite, an impossibility; and I have myself analyzed charcoal

containing $2\frac{1}{2}$ per cent. of sulphate of lime; while in the refineries on the Clyde it is a very extreme case when 1 per cent. is present, the usual amount in old charcoal being from $\frac{1}{2}$ to $\frac{3}{4}$ per cent. Hard waters also contain usually a good deal of lime in the form of bicarbonate, or carbonate dissolved in solution of carbonic acid; and this carbonate is readily absorbed by charcoal, at least when it is abundant, and sometimes fills up the pores to such an extent as to render the char practically useless.

(To be continued.)

THE PROGRESS OF THE SUGAR INDUSTRY.

(*From the Journal des Fabricants de Sucre.*)

THE Governor of Martinique recently hazarded some assertions to the effect that the sugar cane industry is now so prosperous that it outrivals the beet, and that the latter is in many parts cultivated for the production of alcohol instead of sugar; this may be answered by the production of [last season] of 800,000 tons of beet sugar in Europe, which exceeds that of the rich and fertile island of Cuba by 100,000 tons.

Were it not for the drought of this year and for the war, which will, especially in Germany, cause for want of labour the abandonment of a part of the beet crop—but for these two scourges, Europe might have produced in 1870-71 one million tons of beet sugar.

Thus, for a long time past, the new industry has answered by continued progress those who denied its vitality.

On the other hand, it would be a great mistake to suppose that the supremacy of the sugar industry will soon belong to the beet alone. The sugar cane is by no means dead; on the contrary, it is in process of revival, from its having lately adopted the same mechanical and chemical improvements which have raised the continental sugar industry to such a pitch of commercial prosperity.

It is necessary to have known the [French] Antilles prior to 1860, in order to recognise the transformation which has rapidly

taken place. The nett production has been doubled, the gain being 50 per cent. on the growth of the cane, and 50 per cent. on the yield of sugar.

In less than ten years all the old sugar mills of Guadaloupe and Martinique will have been replaced by grand central factories, which will be the means of saving these islands from the misery and ruin to which they were inevitably drifting.

If, from the use of more rational processes, the production has been doubled, what would be the results of similar improvements in the Spanish, English, and Dutch colonies, in Louisiana, Brazil, in short wherever the sugar cane is grown? As it is, there is a steady extension of cane cultivation which happily is counterbalanced by increased consumption.

When we know the marvellous results of our own sugar agriculture, how both the soil has been improved and the yield and quality of all the crops enhanced, the sugar cane cultivation appears everywhere in a state of striking inferiority. The tropical plant takes much from the soil, and returns it scarcely anything: it reigns alone, but only by living on its own substance, and without the power—Phœnix-like—to rise again from its own ashes. In the recent report presented to the Chamber of Commerce of Reunion are some figures extending from 1815 to 1869 inclusive, which show that this colony has exported in that time about 958,000 tons of sugar, and that it is calculated that this quantity of sugar has withdrawn from the soil 23,000 tons of potash and 20,000 tons of phosphate. If Reunion had exported only pure sugar (C^{12} H^{11} O^{11}), it would have been in the state of the greatest prosperity, but it has deprived itself of all fertilising materials in the molasses, scums, megass ash, and of a portion of manure in the sugar itself by the impurities it contains.* This is an argument in favour of making white sugar, the lower the sugar the more it is charged with molasses and salts, the more does it deprive the soil of its fertilising principles.

* The question as thus stated resolves itself into an absurd proposition,—that it would be better to make only pure sugar, and return everything else coming from the cane to the soil.—*Ed. S. C.*

Our colonies ought, therefore, if they would regain their former prosperity, to ensure the continuance of the best systems of manufacture as carried out by the best machinery, and to insist on the law of restitution, outside of which there is neither present success nor future prospect for the agriculture of any country. The farm manure, the scum, the residues of distillation of syrups or molasses, the megass ash, the megass itself where possible, should be returned to the soil, in order as much as possible to diminish the use of foreign manure. Let us take example of the beet root, which is following more and more closely the doctrine of restitution. Half a century will soon have passed since the beet was first cultivated in some districts of the departments of Nord, and far from complaining of exhaustion of the soil, they have never been more prosperous or successful in procuring abundant and various crops. Our colonies have much to learn and more to apply in the matter of rural sugar economy, if they entertain the ambition either of vanquishing, or of competing with the beet sugar manufacture in the markets of the world. There is much room for improvement, though immense strides have been latterly taken since the abolition of wind and cattle mills, and the ancient pans of Pere Labat adorned with their legendary negro. The sugar cane is comparatively well pressed in the central factories provided with powerful mills; but, notwithstanding, in the best conditions only 70 to 90 per cent. of the juice contained in the cane is obtained, and this return appears to us insufficient. In the defecation of the juice it has been submitted to but few different methods, and there remains to be tried, on a working scale, the action of different purifying agents of great power, such, for example, as lime and carbonic acid, which might realise in the colonial sugar mill modifications as great as their employ has effected in the beet sugar factory. In a word, with the naked fire battery, 5 to 6 per cent. of sugar was extracted; in the central factory, 9 or 10; and it needs only fresh efforts to obtain 12 per cent. For our part, we may say we have full confidence the latter figure will be reached; it is not the ultimate end of progress, and corresponds only to two thirds of the sugar allowed to be present in the tropical plant.

FACTS ABOUT LOUISIANA.

BY A. N. WALLACE,

New York.

REQUESTS from the Northern States and Europe, for information regarding the Agricultural and Commercial Staples and other products, and characteristics of the State of Louisiana, have increased so largely with the expanding interests involved in the sugar, cotton, and rice trades, in connection with the prospects for purchasing lands, and the introduction of emigrants, that a brief review of prominent facts and considerations may prove interesting to many readers.

The great Mississippi, rising near the uppermost limit of our country, traversing in its course over four thousand miles through the most fertile portion of our vast domain, finally washes the soil of Louisiana a distance of eight hundred miles, and has for ages past been bringing down with its mighty current the soil of which eight millions of its acres are composed, gathered by a thousand minor streams from ten thousand different hills of varied formation—making a compost which surpasses any soil in the world in its natural fertility, whilst the genial atmosphere of its climate honours all drafts made upon its bounty.

THE POSITION OF THE STATE

favours the cultivation of nearly every valuable commercial product of the Continent, and its facilities for inland and foreign trade offer advantages unsurpassed by those of any country in the world. It should also be borne in mind that Louisiana is not a new and undeveloped country a thousand miles from the seaboard; with the cost of producing two bushels of grain to transport one to the consumer, but a region possessed of towns and cities, schools and churches, railroads and great lines of water transportation—the gateway through which half the products of the Continent must

pass,—and yet the cheap and fertile lands of the State offer all the advantages of a new country.

THE CANE SUGAR PRODUCT.

The fact that nine-tenths of the cane sugar produced in the United States must, of necessity, come from Louisiana, and that the State has enough sugar lands advantageously situated, and of rare fertility, to meet, when properly worked, nearly the world's demand, renders its sugar culture interest of vast importance to the country. The preference given to Louisiana sugar, and the political disturbances in Cuba, whence the world's markets have formerly derived nearly one-third of their supply, are having great influence on the product, and greatly stimulating the production of the staple. All that portion of the State south of the 31st degree of north latitude, or about one-half, embraces what is known as the sugar district, although it is profitably grown in many instances north of that, with a varying capacity to produce from one to two hogsheads of sugar, and two to four barrels of molasses per acre. In 1792 Stephen Bore, finding his indigo crop a failure for three successive years, determined to try the cultivation of the cane. His friends protested against this seeming folly of an almost ruined man; but the attempt proved a success, and through his efforts one of the most productive branches of industry on the Continent was established, gradually increasing from 30,000 hogsheads in 1835, to 459,410 hogsheads in 1861.

On a plantation below New Orleans, which had been cropped forty years in succession, thirty loads of cane, weighing 60,000 pounds, were taken from an acre of ground in 1867, when the plant contained less than the average of saccharine matter. After passing between the rollers of the grinding mill these 60,000 pounds of cane were converted into 48,000 pounds of juice, and 12,000 pounds of *bagasse* crushed so dry as to readily burn in the sugar house furnace. The product of the 48,000 pounds of juice was 1,950 pounds of sugar.

FACTS AND FIGURES.

A gentleman of the parish of St. Landry writes under date of January 5th, 1869:—The following is a correct statement of my crop:—Ninety-two acres of plant cane and 82 acres of corn, cultivated by 12 men, produced 193 hogsheads of sugar, 341 barrels of molasses, and 1,600 bushels of corn. We ground 72 acres of cane, and sold 3 acres for planting for 1,000 dols. The 72 acres of cane produced 193 hogsheads of sugar, weighing 218,090 pounds; 341 barrels molasses, 14,322 gallons, averaging, per acre, 3,029 pounds sugar, and 200 gallons molasses.

		Dols.
Net proceeds from the above, including the 3 acres of cane		32,221·18

EXPENSES.

For cultivating the crop	1,225 00	
For taking off the same	1,551 31	
For pork in lieu of wages	662 00	
Sugar hogsheads, molasses barrels, repairs to sugar house and other expenses	3,500 00	6,938·31
		25,282·87

We consumed in making the sugar 660 cords of gum wood. In taking off the crop we hired 30 extra hands, whose wages are included in the above.

Number of days cutting cane	42
Number of days grinding	21

Total capital invested 40,000

The following table shows the yearly and total product of a sugar plantation near Donaldsonville, of about 1,300 acres, 700 to 800 in cultivation, for 17 years, including the four years of war, in which the working of the place was very much interrupted:—

Year.	Hhds. Sugar.	Proceeds of Sugar and Molasses. DOLS.
1853	572	23,107·33
1854	630	33,580·50
1855	425	40,616·70
1856........Sugar crop a total failure in Louisiana.		
1857	570	42,638·46
1858	1,002	80,742·94
1859	619	59,983·24
1860	453	37,844·57
1861	527	37,466·98
1862*	130	15,507·39
1863†	280	44,395·60
1864‡	72	20,838·24
1865	Cane used for plant.	
1866	252	43,997·02
1867	217	40,000·00
1868	275	48,900·00
1869	430	71,760·00
17 Years.—Total	6,454	641,378·97

THE PRESENT LABOUR SYSTEM

has adjusted itself to the changed condition of affairs, and is proving equally as reliable as in the North. The custom of withholding one-half the wages until the completion of the yearly crop induces compliance with the contract upon the part of the labourer, securing his services for the whole year with an amount of labour equal to that of any portion of the North. The labour is usually divided into three classes, and known as first, second, and third-class hands, generally receiving ten, fifteen, and twenty dollars

* In the beginning of October a large, fine crop on the fields, but was nearly all lost by the stampede of the negroes.

† Nearly all the serviceable negroes seized for military use.

‡ Rest of able-bodied negroes pressed by General Banks for military purposes, &c.

per month—on most of the plantations averaging about fifteen dollars.

PARTICULAR ADVANTAGES OF SUGAR CULTURE.

The sugar cane is as little liable to disease, or injury from insects, and ordinary accidents, as any crop produced in the country. As the crop is laid by in June or July, and thus remains until October or later, it exempts the laborer from exposure, giving him time to harvest his corn crop and prepare for grinding and such other work as may be necessary. It can be carried on by co-operative associations, like the dairy business of New York; the sugar houses, like the cheese factories, working up the products of the surrounding country, producing a finer article for market with less expense and greater returns to the planter. Sugar producing being at the same time an agricultural and manufacturing business on a large scale, machinery can and will be successfully applied to the cultivation of the cane in future. The steam plough has already been successfully introduced, working to a depth of twenty inches, and a capacity of twelve acres per day; and we are assured by a Northern planter, settled on the Bayou Teche, that, by means of improved implements and some simple contrivances of his own, he has greatly cheapened the cost of cultivation.

It has been ascertained by analysis that the sugar cane of Louisiana contains 14½ per cent. of sugar, two-fifths of which is thrown away in the *bagasse*, or what is left of the canes after they are pressed between the rollers of the sugar mill, and on most plantations are used for fuel. The *bagasse* from the canes required to make a hogshead of sugar is equivalent to half a cord of wood, when used as fuel, and can be made to produce seventy gallons of spirits. Mr. Bringier, one of the most experienced and scientific sugar producers, says that the skimmings from the juice required for 1,000 pounds of sugar, are equal to eighty pounds of sugar. Could this refuse, now thrown away, have been utilized the past season, or worked as closely as in the manufacture of maple sugar or cheese in the state of New York, there would have been 600 hogsheads more produced, or an amount to the value of 75,000 dols.

And again, by chemical analysis, it is demonstrated that the product of molasses, which is now about seventy gallons to the hogshead, is the result of a defective process of manufacture, and should not amount to one-twelfth of the sugar.

By the method of diffusion, applied to the manufacture of beet sugar, it is stated that all the sugar can be extracted. Many experiments are now being conducted upon this and other processes for manufacturing sugar. Can a larger or more profitable field be found for inventive genius, or one so sure of just rewards? And still if, with the present yield and waste, the sugar plantations and farms of Louisiana are so profitable, what would be their value if the profits could be multiplied by saving without additional labour or cost, nearly one-half of the sugar which is now grown, but actually thrown away.

In the early period of sugar raising in Louisiana, the tracts cultivated in cane were comparatively small, and the operations for grinding and boiling of the simplest description. Horse mills were used for grinding the cane, and kettles for evaporating the juice. With the recent improvements (apart from the large mills now in use), it has been demonstrated that cheap, portable cane mills, driven by steam or horse-power, and improved evaporators, costing in all but a few hundred dollars, may be made to take the place of the large and more expensive mills. It has been said that these inexpensive mills will press the cane as dry as it can be pressed by the large mills; also, that the evaporating pans will make better sugar, and a larger percentage in proportion to molasses, and with more economy, than the kettle train. The small sugar farmer cannot, of course, produce with this simple apparatus so fine a quality of sugar as that manufactured on the great plantations, by the aid of expensive machinery, centrifugals, &c. An apparatus costing not more than 400 to 500 dols. enables a farmer to take off a crop of from thirty to fifty hogsheads of sugar; and it may be safely said that in an ordinary season the profit of this crop, after paying all expenses, including machinery, will be equivalent to the total expenditure for land, and all necessary expenses of a judicious planter. The raising of cane for planting must, for years

to come, be a most remunerative business. The price of standing seed cane last year was from 125 to 175 dols. per acre. One acre of good standing cane will plant about four acres of ground. This is done every third year; the canes growing from the stubble the two other years are called ratoons. Many sugar growers now plant cane in the fall, before beginning to grind, although it can be done any time before the 1st of March. The after-cultivation closely resembles that of corn when planted in drills. It is usually planted in a furrow from four to six feet apart, and with plenty of seed, two canes side by side. Under the present system of labor, one hand will cultivate eight acres of cane (besides the other crops for his support), which, at ten cents for sugar and sixty cents for molasses, would be about 1,350 dols. The sugar crop of 1861, in Louisiana, or on the breaking out of the war, was 459,410 hogsheads, averaging about 1,150 pounds each, which, selling at the extremely low price of 54.62 dols. per hogshead, amounted to 25,095,271 dols. There were in operation at that time 1,291 sugar houses, from which this large amount was produced. In 1869, five years after the close of the war, during which time nearly all the plant cane was lost, the product was 87,090 hogsheads, which were sold for 12,000,000 dols. The sugar houses in operation last season were 817, of which 764 were working by the old process, and 53 producing refined and clarified sugar.* Nearly all of these are now operated by steam. The average of molasses is about 71 gallons to the hogshead. It might also be added, that the grades of sugar are greatly improving with the introduction of new modes and processes of manufacture, and the day cannot be far distant when the finest grades in the market will be produced on many of the plantations without the aid of the refiner.

An examination of the map of the State will show the most perfect and natural system of navigation and drainage in the world; with thirty millions of acres, superficial area, there are twenty

* In addition to the above, about 300 more planters will be prepared to grind their crops of the present season, which will make 1,117 sugar houses in operation, against 1,291 at the commencement of the war.—*American Paper.*

thousand miles of river, lake, and bayou navigation. What untold millions have done for the people of New York in the Erie and other canals, *Nature* has multiplied five times for Louisiana, giving nearly all the planters of the State a water communication with all the world. In fact, it has been said that it was impossible to find a point in the State twenty miles from navigation. In the survey of the State, particularly on the borders of the streams, the plantations and farms are located without regard to sectional lines, and shaped to correspond with the bend of the river or bayou, converging or diverging as they recede from the streams, thus giving a greater number of water fronts to the occupants, and allowing them to ship their heavy and bulky crops of sugar and cotton with the least possible expense and labor, as it is a well-known fact that throughout nearly their whole extent, the rivers and bays afford a natural wharf, allowing the largest steamboats to land at the very door of the planter.

The health and longevity of the people compare favorably with any other portion of the Union. Lying between the twenty-ninth and thirty-third degrees of north latitude, and owing to its semi-peninsular projection into the warm waters of the Gulf, and the great number of rivers, bayous, and lakes within her limits, the climate is much softer and the temperature more even than in corresponding latitudes in the interior of the country, or even that portion of Texas that lies farther South. The balmy breezes of the Gulf moderate the heat of summer, and the lake and river systems of the interior, which cool slowly, radiate sufficient heat to temper the air during the few cool days of winter. As a consequence, the extreme degrees of heat and cold occuring in New York and the West, are never experienced. The mercury at New Orleans seldom or never rises above ninety-five degrees Fahrenheit, and seldom falls below freezing point. Snow occurs not oftener than once in twelve years. The heat of the North is far more intense while it lasts; the thermometer frequently ranges above one hundred degrees, and the sunstroke or *coup de soleil* is far more common throughout the North than in Louisiana.

Yet sugar and cotton plantations can be bought to-day in

Louisiana—plantations cleared, ditched, and fenced, with comfortable, if not splendid dwellings, at less than the cost of improvements. In no other part of the country are to be enjoyed, at so little cost, so many of the substantial comforts which result from a soft and beautiful climate, an inexhaustible soil, and a wonderful profusion of the fruits of the earth.

The war has so impoverished many of the planters that they have been compelled to relinquish their plantations, while in other instances much of our most productive land lies uncultivated from other causes. Agriculturally, our resources are almost without limit, and with capital we should rapidly recuperate, and progress with giant strides, peculiar to all American enterprise. Our climate is a semi-tropical one; the variety and fertility of the soil is unsurpassed; and every vegetable attains here a more perfect maturity than in any other State of the Union. And when taking into account that there are about two hundred and fifty fair working days on the farm in Louisiana, against less than one hundred and fifty in New York or Illinois, and that the loss of time, interruption of productive labour, and many expenses incidental to winter are avoided; that the laborer does not have to spend a month or two in summer to gather forage for the six months in winter; the cheapness of fuel, dwellings and clothing making it equally remunerative to both planter and labourer.

DR. EISSFELDT'S PROCESS FOR REVIVIFYING BONE BLACK WITHOUT CALCINATION.

BY M. CORNILL WOESTYN.

(From the French.)

M. Eugene Feltz has lately undertaken a long tour through the Sugar Manufactories of Germany: he has turned his attention especially to the examination of the method of Dr. Eissfeldt, which, on the other side of the Rhine is regarded as a great progress accomplished in manufacture.

In the Eissfeldt process the bone black to be revivified is first submitted to active fermentation, afterwards in a special apparatus it is successively acted on by chlorhydric acid, steam, and ammonia water. By this means the lime and the products derived from fermentation are separated from the char, which, thus treated, always preserves the appearance and the properties of new, and may serve the purpose of the refiner until completely used up.

In this process the weight of the same volume of char remains constant and nearly equal to that of new. Every one knows on the contrary the considerable increase in weight caused by the repeated calcinations commonly practised: take, for instance, the following figures from my note book :—

Weight of the same volume of char.

New char	19lbs.
After the 1st season	27lbs.
After the 2nd season	33lbs.
After the 3rd season	38lbs.

Without doubt the figures will vary in different *usines*, but in a general sense it is the same in all. When we consider that the power of char is in some manner in inverse ratio to its weight we see what enormous masses are required when the char is old.

The installation of the method is not costly, and it saves a considerable amount of coal, &c., and allows of a considerable diminution of the quantity of char required to keep up the working stock.

The ammonia water from the *triple effet* is nearly all that is needful in the Eissfeldt process.

Dr. Eissfeldt is not a man, who would bring out his process before having fully tested it in his own factory at Sœllingen. This system of revivification is in actual working in a large refinery at Magdeburg, in two factories in Austria, in the new factory of Vasserleben which Dr. Bodenbender set up, in the factory of Schladen, and in a number of others of which the names escape me.

It is in consequence of very conclusive experiments that Dr.

Bodenbender has decided to replace the revivifying furnace by Dr. Eissfeldt's new apparatus.

It might be feared that after a series of incomplete purifications the char might become all at once unfit for use. Dr. Bodenbender has lately imperfectly purified, purposely, some char, about to serve for the filtration of juice. Immediately the juice came in contact with the char it turned milky, and lactic fermentation ensued in greater or less proportion. He thus discovered that the organic fermentible matter acted immediately and did not accumulate.

The doctor has proved practically that the rather complicated process which precedes this treatment by the ammoniacal matters suffices to render all the nitrogenous matters eliminable by the ammonia.

M. Manoury, who represents this process in France, installed one this year in the factory of M. Molinas. The apparatus was set up under his directions by the *Compagnie de Fives Lille*. M. Manoury could not have employed any persons better able to establish in France a proof of the advantages of the Eissfieldt process.

M. Feltz has been in treaty with the inventor, and our *usine* of Orlovetz will profit this year from the benefits of this new method which will render important service in Russia.

THE CONFEDERATION OF "THE LEEWARD ISLANDS."

THE report of the acceptance, by the Council of Antigua, of Sir Benjamin Pine's scheme for the confederation of the Leeward Islands reached us too late for either note or comment to appear in pages of our last Number.

Sir Benjamin Pine, in his speech to the Council introducing the confederation scheme, laid great stress on the fact that it was no new thing, "no modern device, no scheme of yesterday," but an endeavour to return to a similar form of government which was recognised when the colonies were founded; that since the legislative separation of the islands they had become more isolated from

each other, and their institutions more divergent. He also dwelt on the advisability of islands with common interests being under the same code of laws as far as possible, and further on the economy which would be secured by the government of the islands collectively. He stated that the government had conceded the point that every island should retain the regulation of its own taxes and the control of its own finances, and he concluded, after a speech of considerable length and power, by drawing a picture of the dignity and importance which the Leeward Islands would acquire by their confederation, which, he said, contained within it the germs of progress and expansion, which might ere long take in the neighbouring crown colonies: and he foresaw, ultimately, a "still greater federation which should embrace, not only the islands of eternal summer, but also regions whose inhabitants are refreshed and invigorated by the winter's cold."

Whether convinced by Sir Benjamin's eloquence, or from other causes, the Council accepted the scheme unanimously.

We give the chief points of it below.

That a General Legislative Council shall be established in the Leeward Islands, consisting of twenty members, to consist of a president, three ex-officio members, six nominees, and ten members elected by the Legislatures of Antigua, St. Kitts, Dominica, and Nevis, of which five shall represent Antigua, which five shall be selected from the Legislative Council of the island—one by nomination and four by election. One session to be held in each year, alternately in Antigua and St. Kitts, when held in the latter island the members of the former shall be paid their travelling expenses and expense of living.

The following are the chief subjects which will come within the legislative powers of the General Council:—

Laws relating to real and personal property, wills, &c.; husband and wife, parent and child, &c.; the mercantile and the criminal law; the constitution of courts of law and equity, &c.; the establishment and regulation of a general police force, and other protective forces of the Leeward Islands. The General Council will also have control over the post office and electric telegraph,

quarantine, currency, weights and measures, the audit of the accounts of all the islands, education, immigration, and lunacy.

The expense of the general government to be borne by the islands in proportion to the number of representative members each sends to the Council.

The executive council, the colonial secretary, the attorney-general, and the auditor general of the Leeward Islands to be appointed by the home government.

Although the confederation scheme has been received so unanimously by the Antiguan Legislature, we have reason to know that in some of the other islands opinions are greatly divided, but as the home government have secured the co-operation of the chief of the group, it will doubtless be carried out; and in many respects it will, we believe, tend to the prosperity of all the Leeward Islands.

THE CONTINENTAL BEET CROP AND THE WAR.

A CONTEMPORARY recently observed that it was the Continental beet sugar crop which regulated the prices of sugar, and that in proportion as the yield of beet sugar was above or below the average, so the prices of sugar rose or fell. Although it is by no means correct that the beet crop regulates the prices of sugar, yet there can be no question but that the variations in so large a source of supply have great effect on the market.

On this account it is important to watch closely the circumstances which affect the beet sugar crop in ordinary times, but especially so at the present season, when things are so complicated by the terrible war between the two countries in which more than half the beet sugar is manufactured.

Were it not for the war, there is little doubt but that the yield of beet root sugar would be considerably above that of last season, which was the largest yet known. From French sources we learn that the alternate rain and heat have latterly been most favourable,

especially in those departments where the beet root is most extensively cultivated.

"In happy Belgium," says the *Journal des Fabricants*, "the beet root crop is said to be very fine; there has been much rain, and the only fear is that the beet may increase in size at the expense of quality. Already, in the greater part of the sugar districts, the root is as fine as it was last year in the middle of September. We may count on an extraordinarily good crop, to which it may be added that there are this year a dozen new factories. This season the yield was 45,000 tons, but in the present conditions, that of 1870-71 ought to reach 55,000 tons at least.

"The news from Austria, the Zollverein [Germany], Russia, and Holland, are equally in favour of a large yield, and everything leads to the belief that the coming beet crop will exceed the last by 100,000 tons or more."

More than half this great increase would, but for the war, have been realized by France and Germany; thus, the question is, to what extent the war will affect the gathering and manufacture of the beets in these two countries.

The war having been carried into France, that country will of course suffer most, and in France, we must remember, one-third of the Continental beet crop is grown. Even at present, we are told the sugar trade is in the greatest confusion, the refiners doing scarcely anything. They employ many Germans, who have either been called to serve in the Landwehr, or have been expelled from France by the Government; then the call on all able Frenchmen up to 40 will further diminish their staff of workmen. As regards the growing crops, the journal quoted above said last week, "If the Prussian invasion is not arrested, some of our sugar-growing departments, such as l'Aisne and l'Oise, where there are a large number of factories, may suffer severely in some parts. The group of *Nord* and *Pas de Calais*, the most important of all, is protected by the neutrality of Belgium, as is la Somme, which is not in the way of the hostile armies if their aim is Paris. The department of *Ardennes*, in which the sugar factories are adjacent to Belgium, will not suffer much. Taking

the lowest view of things, we see that the actual damage done to the beet crop will probably be confined to *La Meurthe*, where there are only three factories; to *La Marne*, where there are but few; and lastly, to parts of *l'Aisne, l'Oise, Seine et Oise*, and *Seine et Marne*."

"If the war continue, the want of labour will be felt, and the work will run the risk of standing over later than usual, especially as the Belgian labourers, who supply a number of factories every year, will also be wanting. Fuel may also be scarce, or the wagons for transporting it. But there are still two months before the time for our sugar factories to be in full operation; before that it is probable that the state of things will be altered."

The French organs of the sugar industry thus candidly admit that great loss will probably result from want of labour; but M. F O. Licht, of Magdeburgh, in his last circular, almost ridicules the idea that the sugar manufacture in Germany will suffer from want of labour, yet it would appear to a stranger that the German army, being great part of it drawn directly from industrial pursuits, would affect the labour market very considerably. It is, of course, impossible to estimate with any degree of certainty the loss which the beet sugar crop will suffer; but that it will suffer, and that considerably, if the war is protracted into the beet sugar season, there can be no question.

DINNER TO SIR J. P. GRANT.

A DINNER to His Excellency Sir John Peter Grant, K.C.B., Governor of Jamaica, was given in Willis's Rooms, on Wednesday, July 27. Mr. J. Gurney Hoare, Chairman of the Colonial Bank, presided. Sir James Colvile occupied the vice-chair, and there were present a large number of planters, merchants, and others interested in the colony.

The usual loyal toasts having been duly honoured, the CHAIRMAN proposed the health of Sir John Peter Grant. He said that he (Mr. Hoare) belonged to a family who had always taken a deep

interest in the welfare of Jamaica, especially since the time of emancipation. He had also personally felt great interest, not only in the progress of education in the colony, but from his connection with the Colonial Bank for more than thirty years, in the general condition of its people. They all remembered the time when they were told of bad crops and idle labourers, when men said that there was no such impossible place as Jamaica, and he would appeal to gentlemen present whether a wonderful change had not been effected. Education was prospering, finance was in a good position, and the general condition of the island had been greatly improved. The real author of that change they had met that night to honour. Sir J. P. Grant had been doing good, not only to the planter but also to the honest negro, to whose provision-grounds he had afforded additional protection by the new constabulary. The career of Sir J. P. Grant in the East justified the brightest anticipations of his success in the West Indies. When Macaulay came home from India he was asked who were the men that were most to be depended upon, and among the names mentioned in reply was that of "Mr. Grant." He (the Chairman) was glad to hear that Sir John was going back to Jamaica; he hoped it would be long before his career in that island was closed, and he concluded by heartily wishing him continued success and prosperity.

The toast having been received with great cordiality, Sir J. P. GRANT rose and said that he was unable properly to express his feelings in acknowledging the honour which had been done him. There was a time when it would have been most imprudent for any one standing in his position to receive such a compliment. He saw before him gentlemen representing the planting and commercial interests of the island, and there was a time when it would have been unsafe for a governor, who had to deal with all classes, to receive a compliment from one class; for there were other interests besides that of the planter. Jamaica was not exclusively a sugar-producing colony, although its prosperity greatly depended upon sugar. When sugar prospered, everything prospered; when sugar drooped, everything was depressed. There was a time in the

history of the colony when everybody was the enemy of everybody else. Thank God! that was now at an end. All classes worked together most harmoniously; indeed the change in public sentiment in that respect was absolutely miraculous. Before going to Jamaica he had received a deputation from a society which had always taken a noble interest in the welfare of the negro, and he said to them that the only way of protecting the well being of one class was to observe strict justice towards all classes. From that principle he had never swerved, and the result had shown that he had not been wrong. The Chairman was quite justified in his anticipation of prosperity for Jamaica. He (Sir J. P. Grant) was perfectly satisfied the colony had begun to prosper. When, some time ago, he first hinted that it was not "all up" with Jamaica, he was looked upon as a very preposterous sort of person. Well, some years since, and the colony was on the verge of insolvency; but he could now confidently appeal to the Chairman himself as to the amount of the surplus standing to its credit. They had stopped the career of borrowing money, and had, on the contrary, begun to pay off, whilst arrangements had been made to reduce the interest upon the public debt still outstanding from six to five per cent. They had commenced to reduce taxation, and improvement in the financial position had been effected with very little loss to individuals. There was more strength, more solid wealth in the island of Jamaica than many persons would believe. Too much credit had been attributed to him. Whoever might have been at the head of affairs very great improvement must have resulted from the mere change in the constitution, and he had received the utmost assistance in the task he had undertaken, not only from the paid, but also from the honorary officials of the island, some of whom he was happy to see around him. He could not sit down without thanking those gentlemen—especially the custodes and unofficial members of the Council—for the loyal and effective assistance which they had rendered to his Government. Again expressing his thanks for the manner in which the toast had been received, his Excellency resumed his seat amid loud cheering.

SIR JAMES COLVILE then proposed the toast of "Prosperity to

Jamaica." He represented the third generation of a family interested in that colony, although he was personally better acquainted with the East than with the West Indies. He had not the advantage of his friend Sir J. P. Grant, who had distinguished himself both in India and Jamaica. He would not go back to what were called the palmy days of Jamaica—to the days when fortunes were made with great rapidity—to the days when slavery prevailed; these had vanished into the limbo of the past, but he would refer to the condition of the colony in more recent times upon which to found an estimate for the future. He had read the last report of Sir J. P. Grant, from which he gathered that his Excellency had succeeded in making two ends meet. There never had been upon this earth a country that prospered whilst making deficit after deficit. But they had now realised a surplus. Sir J. P. Grant had adopted the principle of retrenchment where it was possible, and of spending liberally when it was necessary for the effective maintenance of the institutions of the colony. He congratulated the Governor upon his legal improvements. It was, above all, essential not only that justice should be impartially administered, but that also the people should believe that it was so administered. Upon the whole he was convinced th t the present result of Sir J. P. Grant's government were satisfactory, and they were justified in looking for still greater results in the future. (Loud cheers.)

The Hon. BENJAMIN VICKERS endorsed all that had been said as to the improved state of things in Jamaica. He cordially approved of the policy of the Governor, who, he was glad to hear, intended to return to the colony to complete, he hoped, those reforms which had been so well commenced.

Mr. BARROW approved generally the present management of affairs in the island. The position of Jamaica was much better now than formerly. He was one of those who took part in the surrender of the constitution, and he considered that he had received full value in return. The institutions were now placed on a better basis, and although fortuitous circumstances might have aided in producing this result, yet, looking at the peaceful condition of the people, the healthy state of commerce, the steady rise in the value of property,

the conclusion was irresistible that other than merely fortuitous circumstances had been at work. He was speaking the sentiments of his countrymen when he said that the Governor would be received with a warm welcome on his return to the colony. (Cheers.)

Mr. JAMES HARVEY said that the colony had reached its lowest ebb in 1865, and that the change had given rise to the brightest hopes of future prosperity. The toast "Prosperity to Jamaica" was then drank with all honours.

Mr. CARSON proposed the "Church in Jamaica." The Ven. Archdeacon CAMPBELL, in responding, said that Sir J. P. Grant had effected an improvement in the moral world of Jamaica, as well as in its agricultural or material condition. The people had been taught the virtue of self-reliance. A great impetus had been given to religious education—indeed, they had now almost a perfect educational system, in extending the blessings of which there was an honourable rivalry among all denominations in the island.

The health of the Chairman, proposed by Mr. BRAVO, and duly acknowledged by Mr. HOARE, brought the proceedings to a close.

THE REBELLION IN CUBA.

The accounts of the rebellion in Cuba from different sources and different parts of the island are very conflicting. A correspondent of a Jamaica paper, under date of the 4th July, gives a very discouraging picture of the state of the Spanish troops in Cuba, stating that they had been engaged in several severe conflicts with insurgents, and that the latter were victorious in every instance, and that over 3000 of the former were prisoners. The correspondent, who dates from St. Jago, also states that many sugar factories have been burnt, and that the crop will be a very poor one; and he adds that yellow fever prevails to a great extent in the island.

In the French *Journal Officiel* is a letter of the 7th July, from Havana, to the effect that the activity of the Spanish General in that district has surprised and disconcerted the rebels, who had suffered the greatest loss, that he had taken from them the greater part of their arms and amunition, and had opened negotations for the disarmament of bands of insurgents. The writer adds that the energy with which the Cuban insurrection is being repressed does honour to the Spanish troops.

Correspondence.

To the Editor of the Sugar Cane.

Sir,—

In the July number of *The Sugar Cane*, I see an article on the cultivation of the sugar cane in the Leeward Islands. This article being of a more practical nature than the generality of those in that periodical is a step in the right direction, for, as a rule, it has been too theoretical to be popular amongst practical planters. I regret Mr. Hollins did not go more into details, and hope we shall hear more from him. As the method of cultivation of the cane and the manufacture of sugar vary so very much in this colony from that adopted in the islands and elsewhere, I have thought some of your island readers might be interested in knowing our method of procedure, and therefore submit the following remarks on the cultivation of sugar in British Guiana.

I may premise by stating that British Guiana, although one of the British West India possessions, is *not* an island, as stated in the House of Commons by a member not very well up in geography; it is situated on the north eastern coast of South America, between Venezuela and Dutch Guiana. The settled portion of it is merely an immense level tract of alluvial clay, extending from the sea coast and up the rivers several miles into the interior.

The sugar estates are laid out on the sea coast and the banks of the rivers, all the river estates, with two or three exceptions, being within ten or twelve miles of the coast.

All the land on the sea coast and rivers is laid out in lots, being parallelograms varying from 400 to 700 yards in façade, and extending in depth indefinitely. Wherever a bend in the river or coast necessitates it, a triangular lot is let in like a gusset to make all come square. Some sugar estates consist of only one lot, in which case the cultivation extends as far as six, seven, or even eight miles, whereas the width will perhaps be only 400 yards. Most estates, however, have several lots, in which case the cultivation only extends from two to three miles, according to size.

Each estate is surrounded by earthern embankments or dams;

that in front to protect it against the sea, or river, which, at high water, would inundate the land; that at the back to protect it from the accumulation of bush water, or water which has collected in the bush or savannah, and which is generally several feet above the level of the land;—those at the sides to protect it from the carelessness of neighbours, or from being flanked by the bush, or tidal water.

I will now proceed to describe Empoldering, or the enclosing of the land with the dams mentioned above.

If an entirely new lot had to be empoldered, the boundaries would have to be laid down by sworn surveyors, but, as the only empoldering now done is the extension of the old lots, surveyors are not required.

The first thing to be done is to extend the old side dams, or, as they are called here, side lines, in a straight line. This is done by taking the exact centre of the old dam for 80 or 100 yards, along which centre you plant three or four sticks (called here, "lining pins"), about 7 or 8 feet high, perfectly upright, and in such a position that standing behind the first pin, and casting your eye along, all the pins appear but as one. This row is now extended to the level land, or savannah, at the back of the estate, a gang of men going in advance with cutlasses and axes to clear away the grass, bush, and trees that are in the way of the line that is being struck.

The head man, or liner man, stands behind the first pin; his assistant goes about thirty yards beyond the last pin with a bundle of long sticks; he then takes one, and sticks it in the ground, as near as he can judge in a line with the other; if placed too much to the right, the head man waives his left hand, and *vice versâ*, just as is customary in land-surveying. When the exact spot is found, the assistant sticks the pin firmly into the ground, the head man advances to the next pin, and the assistant another 30 yards, and the process is repeated. When the two side lines have been extended the required distance, the back dam is lined at right angles to them.

All the grass, bush, &c., is then cleared away for at least 30

feet on each side of the lining pins. This space of 60 feet is then divided as follows:—6 feet on each side of the lining pins, or 12 feet for the centre; 12 feet on each side of this for the parapets, and 12 feet again on each side for the trenches, from which the earth is taken to form a dam. In the centre of the centre division a trench (called here, a "blind trench") is dug, 3 or 4 feet wide and 3 feet deep. The earth from this is placed on both sides, but within the centre 12 feet. The two trenches are then dug. The first 12 inches being full of the roots of grass and bush, are placed on the space left for the parapets; the stiff, clean clay that is now dug out is thrown into the blind trench in the centre. Men with wooden rammers then ram and puddle it till the blind trench is full. As soon as this is the case, the earth from the trenches is thrown on to the centre space until an embankment of 4 or 5 feet high is raised. The sides are then neatly pared with a slope (called here, "giving it a foot"), making the dam 12 feet wide at bottom and 9 or 10 feet wide on top. This is what really forms the dam, but to strengthen it more earth is taken from the trenches, and the corners formed by the dam and the parapets are filled in, thus forming a rounded dam 36 feet wide, and about 5 feet high.

This work must of course be done in dry weather, when there is little or no water on the savannahs; and what water there is must be drawn off by the draining trenches and sluices of the estate.

The next operation to be performed is the laying out of the land.

N. W.

British Guiana, August 6, 1870.

To the Editor of the Sugar Cane.

Sir,

I have just returned from a tour through the beet root districts of Flanders and Northern France, which, though much improved by the last fortnight's rain and glorious sunshine, are generally patchy and indifferent, having had a bad start, with so dry a spring The best I saw was on the trenched country around Dunkirk, Tounes, Dorny-Douy, and Cassel.

Indeed, all through the Flemish farming was yielding crops of wheat, barley, and oats, such as I have nowhere else seen, though have during the past month or six weeks gone through the best districts of Scotland and England. and from Calais to Holstein, and it is all the result of high tillage, with judicious artificial manuring, and of yeomen farming their own lands of moderate extent, and free from exacting leases and obsolete rotations of crops.

Yours truly,

THOMAS R. ARNOTT.

Seaforth, Liverpool, July 30, 1870.

[The above was received too late for our last month's issue.]

NEW PATENTS.—FROM THE MECHANICS' MAGAZINE.

98 E. ROUSSEAU, Paris. *Sugar.* Dated January 12, 1870.

In order to prepare the sucrate from which sugar is obtained, the saccharine juice is exhausted from the vegetable substance by any of the methods usually employed for the purpose, such as rasping and pressing, or by maceration, or simply by pressure in the mill, as is now the case, to extract juice from the sugar cane The juice in a more or less pure state is desiccated by means of a variable quantity of lime according to its nature, but the quantity of lime must be sufficient to carry away the larger portion of those matters which would prevent the evaporation or injure the sugar. The liquid juice is drawn off clear, or is filtered in order to separate the scum and froth, and according as the juice is more or less pure it may be admitted to the action of carbonic acid even to saturation in order to facilitate the evaporation. When the saccharine juice is considered sufficiently pure it is evaporated in the ordinary manner, either in open pans, or in any improved apparatus, until it arrives at the desired density This density is indicated by the greater or less richness of the syrup in the sugar; it varies when cold from 25deg. to 35deg Baumè. The lime is prepared in the following manner:—On any convenient quantity of quicklime placed in a suitable vessel is poured a sufficient quantity of water to slack it, disintegrate it, and dry it.—Patent completed.

FRENCH PATENTS.—FROM "LA SUCRINE INDIGENE"

87,898. MM. DUPONTRENE et LEBOULENGER. *The substitutition for the animal black employed in the manufacture of sugar, or the clarfication of beet juice, of a composition very much more economical in price.*

The Patentees employ as agents of filtration all carbonized matters contained in the animal, vegetable, or mineral kingdom, such as cinders, coke, wood charcoal, carbonized turf, animal black, &c.

The filters are formed of 1-15th of their volume of animal charcoal, which is placed at the bottom; it is then filled up with the other matters named above, which will produce, according to the Patentees, a real economy.

It must first be established, before this economy is admitted, that the other matters have sufficient decoloring or purifying power.

87,801 MM. DREYFUS, FRERES, à PARIS. *Improvements introduced in divers apparatus, and in the mode of their application, in use in sugar manufactories and refineries.*

This patent comprises a principal patent and a certificate of addition. The object of the principal patent is a mechanical means of filling the loaf sugar moulds. At the bottom of the heater, provided with an agitator, and above the level of the loaves, a system of valves is placed, so worked by a single lever as to dispense with carrying the syrup in filling the moulds. The certificate of addition has two objects. The first is applied to the vacuum apparatus. It aims at increasing the heating surface and at rendering it removable. It consists in a horizontal tubular heater (independent of the covering), to which a great surface may be given, and which may be withdrawn by unfastening a large joint. To facilitate this operation the heater is suspended from rollers which roll on an iron double T fixed solidly in interior of the copper (pan) (heater). The second aims at increasing the resistance of the soldering of the iron stays to the copper tubes. We know that ordinarily the junction of the two pieces, tube and stay, is made on another part by a soldering around of the collar. But this last because of the little hold on the surface, very nearly smooth, leaves much to be desired on the score of solidity. The better to unite the two pieces M. Dreyfus makes on the round, and at a little distance from the tube, a circular groove, dovetailed, in which the solder is placed, which thus forms a sort of clamp.

87906. M. Hamelle, à Saint Quentin.

Substance suitable to replace bone black in all the operations of manufacture to which it has been applied.

The idea which has guided the patentee in the composition of the substance which he proposes as a succedaneum of animal charcoal has been to enclose, in covering, resistant and porous, certain active substances capable of eliminating foreign minerals, or organic matters which soil the syrups to be purified. Calcined clay may be used for this purpose, if porosity can be given to it, and if its density can be augmented, necessary conditions for filtration and revivication. M. Hamel believes that he has satisfied these conditions by a mixture of clay, oxyde of iron, chalk, &c., according to the use for which the compost is intended. In the manufacture of sugar this is the proper mixture, but it also needs a decolorizer, for which a quantity of blood is added, or any other animal matter which by heat can be converted into charcoal, the best decolorizer known. The following is the composition given by M. Hamelle :—

100 parts ferruginous clay,
5 „ fossil phosphate,
25 blood defibrinated, or not.

The whole is crushed well, mixed, and then lightly burnt until of a dark red colour.

EXPORTS FROM HAVANNA AND MATANZAS FROM JANUARY 1ST TO JULY 5TH, 1870, IN THOUSANDS OF TONS.

	1870.	1869.	1868.
Great Britain	137	105	117
United States	127	146	122
Northern Europe	8	7	14
France	37	32	31
Spain	42	31	29
Southern Europe	3	2	3
Other Ports	6	5	4
	360	328	320
Stock in Havanna and Matanzas	117	104	121

SHIPMENT OF SUGAR FROM MAURITIUS.

	1869-70.	1868-69.	1867-68.
United Kingdom	37,801	20,993	47,745
France	11,155	5,279	1,655
New Zealand	3,321	2,564	....
Australia	45,347	31,483	33,880
Cape of Good Hope	2,226	830	1,806
Bombay	29,207	13,418	25,751
Other Ports	1,199	695	652
	130,256	75,262	113,489

COMPARISON OF STOCKS OF RAW SUGARS IN THE CHIEF MARKETS, TO END OF JUNE, IN THOUSANDS OF TONS.

	1870.	1869.	1868.
31st January	442	410	331
28th February	441	380	323
31st March	465	366	327
30th April	502	398	332
31st May	499	440	376
30th June	520	463	409

CONSUMPTION OF SUGAR IN EUROPE AND IN THE UNITED STATES, IN THOUSANDS OF TONS, FOR THE YEARS ENDING JUNE 30TH.

	1870.	1869.	1868.
Europe	1315	1235	1174
United States	460	392	406
	1775	1627	1580

STOCKS OF RAW SUGAR IN THE CHIEF MARKETS OF THE WORLD, IN THOUSANDS OF TONS, TO THE 30TH OF JUNE.

	1870.	1869.	1868.
United Kingdom	155	100	99
France	65	57	66
Holland	53	55	49
United States	146	156	91
Zollverein	5	10	4
Havanna & Matanzas	95	84	101
TOTAL	520	463	409

SUGAR STATISTICS—GREAT BRITAIN.

To 20th August, 1870 and 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	45	4	3	22	75	34	79	13	8	38	138	124	44	9	5	16	75	123
British East India	11	1	..	..	12	8	6	..	..	..	6	12	9	3	..	..	12	10
Mauritius	5	1	..	..	6	3	13	2	7	5	27	16	11	2	9	5	26	20
Cuba	7	6	5	21	39	31	10	16	26	69	121	76	12	13	21	55	101	65
Porto Rico, &c. ..	4	8	..	1	14	5	6	19	1	4	30	12	5	12	..	4	21	11
Manilla & Java ..	32	10	..	1	42	48	14	11	3	3	31	37	13	8	3	4	33	30
Brazil	..	20	1	5	25	18	1	38	3	14	56	50	1	26	4	11	42	52
Beetroot, &c.	1	..	..	1	3	2	15	6	3	14	38	24	16	7	3	17	43	25
Total, 1870 ..	106	51	9	51	217	150	144	106	51	147	448	350	115	80	47	111	353	339
Total, 1869 ..	84	32	5	29	Increase 67		133	68	43	106	Increase 98		121	73	42	102	Increase 14	

STATE AND PROSPECTS OF THE SUGAR MARKET.

For the past month, in consequence of the general stagnation in trade caused by the war between Germany and France and the (temporary) advance in the Bank rate of discount, Sugar of all descriptions has been unusually depressed.

Imports have continued to increase largely; up to the 20th of August they were over 97,000 tons in excess of those at the same date in 1869. The increase in stocks to the same period is nearly 67,000 tons, and of deliveries about 14,000 tons.

In consequence of the falling off in the exports from France, loaf sugars are rather dearer; common refined lump is also 1s. above last month's market price, being quoted in London 40/6 to 41/0. On raw sugars of all sorts there has been a decline from last month's prices; near the end of the month large sales of British West India Muscovado were made to refiners, in consequence of which rather more firmness was shown, and part of the decline recovered, but only temporarily.

No. 12 Havana afloat is quoted at 26/9 to 27/0 per cwt., being 1/0 per cwt. less than at the same date last year, and 2/0 per cwt. more than in 1868; whilst good to fine Pernambuco is now worth 19/0 to 20/0 per cwt,, being fully 4/0 per cwt. less than in August 1869, and 2/6 less than at same date in 1868.

Accounts of the cane for the next crop are generally good; as regards beet, the crop is very large in most districts where it is grown. How serious may be the mischief done to it in France by the contending armies, and how great the want of labour for its manufacture, it is impossible to estimate.

☞ *Communications and Advertisements to be addressed to the Editor of "The Sugar Cane," Galt & Co., Publishers, Manchester,*

THE SUGAR CANE.

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☞ The writers alone are responsible for their statements.

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ON ANIMAL CHARCOAL,

PARTICULARLY IN RELATION TO ITS USE IN SUGAR REFINING.

BY DR. WALLACE, F.R.S.E., GLASGOW.

BEING THE SUBSTANCE OF A LECTURE DELIVERED BEFORE THE MEMBERS OF THE PHILOSOPHICAL SOCIETY OF GLASGOW. REVISED BY THE AUTHOR, FOR PUBLICATION IN "THE SUGAR CANE."

(Continued from page 510.)

LET us now turn for a brief space to the offices fulfilled by the various ingredients of charcoal. And, first, let us inquire to which of its constituents does it owe its properties, and what are these properties? Charcoal, that is, animal charcoal, has a powerful affinity for—or at least, as that phrase may be objected to, a great power of absorbing—gases, colouring matters, and mineral salts which are only slightly soluble in water; all of these being in solution. It is with colouring matters that we have chiefly to do in sugar refining; but not entirely so, for raw sugar contains vegetable albumen and various gummy and other matters, which for convenience are grouped under the general term of extractive matter; and these are as readily absorbed as the true colouring matter, and their removal is quite as essential. So that if we could practically bleach sugar by sulphurous acid, chlorine, ozone, or

some other chemical agent, we should still require to use charcoal to get rid of the extractive matter. I have found by experiment that ordinary egg albumen is absorbed in large quantity by charcoal, and also gum of the ordinary soluble kind; and it is remarkable that both of these substances have an insoluble modification, and I am inclined to think that this has something to do with their absorption. Again, charcoal, at least when not too old, readily absorbs a considerable quantity of iron, so that liquors contaminated with that metal are completely freed from it by passing through a cistern of new char.

The ingredient which exerts this powerful action is evidently the nitrogenous carbon; for if we burn charcoal perfectly white, not only on the outside of the grains, but to the very centre of each particle, it no longer retains *the slightest trace* of decolorizing power. This I have proved by actual experiment, and is not a mere opinion. But it is quite evident that the carbon owes its extraordinary powers to its extreme porosity, the particles being infinitely comminuted and kept asunder by admixture with ten times their weight of phosphate of lime. The effect produced upon sugar liquor is truly wonderful. Although of a dark reddish-brown colour when run on to the char, it comes away, for a time at least, perfectly colourless. After running for some time it begins to lose its power—in other words, the pores becomes more or less saturated—and the liquor gradually acquires, first, a pale lemon yellow, and then a brownish colour. The sugar refiner takes care to economize his char as much as possible by passing through it, first, good raw sugar, afterwards an inferior sort, and lastly syrups from the drainage of previous refines.

But although the carbon is the essential decolorizing ingredient, yet there is another substance in charcoal that exerts a very marked influence upon the process of sugar refining, and that is carbonate of lime. This ingredient is exceedingly useful in neutralizing the small proportion of free acid present in almost all sugars, with the exception of beet; and it is still more important on account of its neutralizing the lactic and other acids formed in the weak liquors during the washing of the charcoal by a process of fermentation

which it is very difficult to prevent. Hence charcoal which has been deprived of all or nearly all its carbonate of lime is very objectionable, and is sure to give rise to sour liquors and the occurence of iron in the lower classes of sugar produced in the refinery. When the water used contains only traces of carbonate of lime, as is the case in Greenock and Glasgow, the proportion of that compound naturally present in the charcoal constantly decreases, until, in pretty old char, it is reduced to about 1½ per cent. It seldom goes below this, and never so far in a refinery conducted upon scientific principles; but I have seen char that did not contain any appreciable quantity. When the quantity falls below 2½ per cent. sour liquors are apt to follow. On the other hand, when very hard water is used, even although sour sugars are used, the carbonate of lime either decreases very slightly or it increases, and sometimes to an alarming extent; and in beet refineries on the Continent, where lime is freely added to the juice, the evil is a very serious one. In this case it closes up the pores, and does a great deal of damage in various ways; and many expedients have been adopted for the purpose of getting rid of it. The old process consisted in treating the char, after re-burning, with 1 or 2 per cent. of ordinary hydrochloric acid, diluted with enough water to wet the char completely. But in this case the saturation, although pretty rapid, was not sufficiently so: the char which first became wet got too much of the acid, which dissolved some of the phosphate of lime; and when the liquid got to the char furthest from the surface it was completely neutralized, and did no good whatever. The process of Mr. Ed. Beanes is a very great improvement upon this system, and has been adopted with marked success in restoring old charcoal which had been used in beet factories, or in refineries where very hard water was employed. It consists in saturating the perfectly dry char with hydrochloric acid gas (dried by means of chloride of calcium), afterwards exposing it to the air until the excess has escaped, and then washing it well with water and re-burning. The use of this process in refineries where the water is not hard, or when circumstances do not require its aid, is not likely to be attended with favourable

results, and even its constant and continued use in any case is a mistake, as it is impossible or at least very difficult to get rid, by washing, of every trace of free acid. On the other hand, it must be allowed that a trace of acid in sugar improves the colour, making it very perceptibly paler or whiter. This is readily seen by adding a drop of any acid, or even vinegar, to a yellow syrup, when the colour is immensely improved. If, however, the syrup is to be boiled down, the acid does far more harm than good, and should certainly be avoided.

Beanes' process and others of a similar nature have likewise been applied with marked success to new charcoal, for the purpose of removing traces of ammonia and free lime, and also a part of the carbonate. When a refinery starts afresh with new charcoal entirely; the use of acid to improve the char, is attended with the best results, but when only 5 or 10 per cent. of new is added to the old char, it does probably more harm than good. That char deprived of its carbonate of lime by acid gives finer liquor than ordinary char, either new or old, is quite undeniable; indeed, the difference is very marked; but upon the whole the best practical results; throughout the whole of the operations of a sugar-house, are obtained when the charcoal contains about 3 or 3½ per cent. of carbonate of lime, and the liquors are as nearly as possible neutral. When a fine yellow colour appears in the crushed sugar produced, as is commonly observed after a liberal addition of new char to the old, it is an indication of the presence of a trace of alkali; while, on the other hand, sugar from very old charcoal, nearly free from carbonate of lime, has always more or less of a gray tint, and a sour disagreeable smell, and such sugar always contains traces of iron.

Another process has been proposed for treating charcoal with hydrochloric acid—that of Mr. Gordon—in which the char is placed in a cylindrical vessel of considerable size, which is then exhausted by an air pump, after which dilute hydrochloric acid is allowed to rush in at a great many points, so as to saturate the char at once. An advantage of this over Beanes' process is that we can in this way apply any given quantity of acid, while

with the gas we must always use excess. Hydrochloric acid, besides removing carbonate of lime, likewise serves to dissolve out some of the sulphate of lime; but this can also be done by washing plentifully, or, still better, by boiling with water.

I have as yet referred only to the decolorizing power of charcoal; but it has another property which, although valuable when the article is used for purifying water and as a deodorizer, is a very serious drawback to its use in sugar refining—I mean its power as an oxidizing agent. If water containing oxidizable organic matter and free oxygen is digested with animal charcoal, or passed through a cistern of it, the organic matter is oxidized by the free oxygen, and the water is rendered purer and more wholesome. The same property can be illustrated in a variety of ways; but the one I have stated is sufficient for our purpose. When we begin to wash char in the cisterns of a refinery, after the syrup has drained away, we have a dilute solution of sugar formed which, in contact with the charcoal and the free oxygen contained in the washing water, becomes more or less oxidized, forming lactic and probably other acids, of which the nature has not as yet been particularly examined. I do not mean to say that we have here direct oxidation of sugar by free oxygen—for that is not the fact—but we have oxidation and alteration of the nitrogenous matters extracted by the char from the sugar: these undergo fermentation, and then re-act upon the sugar, the ultimate result being the formation of certain organic acids. These acids make the washings sour and putrid; but this is not the only evil, for they at once decompose any sulphide of calcium or sulphide of iron in the charcoal; they dissolve carbonate of lime, sulphate of lime, and oxide of iron; and the consequence is that the char washings become so very impure that, when thrown back amongst the other products of the refinery, or mixed with a fresh lot of raw sugar, they cause an immense amount of mischief, and in certain cases have been the means of bringing the operations of the refinery to an abrupt conclusion.

This is a department of sugar refining which, from its importance, has necessarily occupied a good deal of my attention; and I

think I may say that I have made known to refiners, at least to such of them as have thought fit to occupy themselves with the subject, the means of entirely preventing such injurious results. The method recommended is simply this:—While the sugar liquor is on, the char cisterns are kept up to at least 150°,—a temperature sufficient, so long as the liquor is strong, to prevent any fermentation; then, when water is applied for the purpose of washing down the sugar, it is run on quite boiling; in fact, if it has been kept boiling for some time before it goes into the char cistern, so much the better; and so it is kept boiling so long as any of the char washings are to be preserved. When these directions are attended to, there is never any difficulty with sour char washings, or with the presence of iron in the lower-classed products of the refinery. If the char is afterwards washed continuously for ten or twelve hours with boiling water, it will do more good than cold water; and if boiled with water, as in Mr. Gordon's method of treatment, it is even better.

We now come to the re-burning of charcoal, a subject of very great importance to the refiner. The object to be attained is to carbonize the small amount of organic matter extracted from the raw sugar which has not been removed during the process of washing. In order to do this well, the process should be economical as regards fuel; it should allow of the complete carbonization of the organic matters; it should permit of the ready escape of the gases and vapours produced; and it should expose the charcoal for only the smallest possible length of time to the heat required for carbonization, so as to avoid the contraction of the pores of the charcoal by the action of heat, besides all the other evils attending overburning.

There are two distinct kinds of re-burners,—those in which upright pipes are used, and those that consist of horizontal revolving cylinders.

The kind of kiln in general use consists of a series of upright cast iron pipes, generally arranged in six rows of eight or ten pipes each row, three rows being on one side of the furnace and three on the other. The flame of the furnace plays directly upon the pipes,

and the gases are conducted away from the sides of the kiln. The wet char as it comes from the cisterns, is placed upon the top of the kiln, and sinks gradually down as the burnt char in the pipes is allowed to fall into the cooling boxes below. These consist of sheet-iron vessels the same length as the row of pipes to which they are attached, about 6 or 8 feet deep and ¾ inch to 1 inch diameter, and cooled simply by contact with the exterior atmosphere. This kiln is open to many objections. The wet char above prevents the free escape of the gases and vapours resulting from the carbonizing of the char below, and so these vapours are to some extent driven through the hot char downwards into the cooling boxes, from the joints of which combustible gases and steam may frequently be seen to escape, and where masses of ammoniacal salts are sometimes observed to collect. Again, the heat applied is generally far too great; but still it cannot be avoided, as without it the great quantity of moisture present would not be driven off. In fact, the great mistake arises from drying and re-burning in one operation and in one vessel. The relative proportions of units of heat required to dry and to re-burn a given quantity of charcoal has been determined by various authorities, but with very different results. Mr. Gordon gives the quantities as three to dry and one to burn; but my own experiments, conducted with great care, show that with ordinary average charcoal not more than one-fifth part of the total heat is required for re-burning, and with new char the proportion is still less. Now, in the upright pipes the char at the bottom is exposed to the strongest heat, and most unnecessarily so; the strongest heat should be applied where it is most wanted—that is, to the wet char at the top of the pipes. I must say, however, that this kiln has done much good service; and if it were improved, as it might be, it would still be used with advantage. The gases and vapours can be drawn off readily by a series of inverted funnels moved up and down by machinery. This has been patented by Mr. Gordon, and has been found to work admirably in his own sugar-houses. Then, again, the char might easily be wholly or partially dried before being introduced into the pipes—a process which has been

adopted successfully in some refineries. Lastly, the cooling boxes may readily be made of such depth (say 8 to 10 feet) that the char leaves them almost quite cold; or water may be employed in cooling.* With these improvements well carried out, the common pipe kilns might still successfully compete with others of greater pretensions, and the amount of work performed by them might easily be increased to three times the present quantity.

What are known as Chantrell's kilns are constructed of blocks or slabs of fire-brick, and are a clumsy and expensive modification of the iron pipe kiln. I am not aware that they possess any advantage over the latter, and they are in some respects inferior, while they consume a much larger quantity of fuel.

Of cylindrical kilns we have Cowan's, Torr's, Bringe's, Gordon's, Norman's and others. Cowan's is the simplest, but probably also the most defective, and consists of a single cylinder placed horizontally, which is half-filled with char, and then kept rotating over a furnace until no more vapours are given off; after which it is stopped, and the char withdrawn red-hot into iron boxes. In this process a good deal of the char becomes white, gray, or brown, from loss of carbon; and this result arises partly in the cylinder, and partly when the char is withdrawn. In the cylinder the larger particles of the char constantly fall over first, and come in contact with the red-hot metal, and these are always over-burned, while the smaller grains run the risk of not being burnt enough. In most of the later modifications of this apparatus two cylinders are used, one being placed above the other; and this exercises a considerable economy of fuel, the large expenditure of which in the case of the single cylinder is alone enough to prevent its adoption. In Gordon's process, patented in 1866, in which the re-burning however, is only a part of the process, two cylinders are employed for *drying* the char, while the burning is effected in extremely narrow pipes, and occupies only a few minutes. But,

* The water is not applied to the char itself, but is contained in a series of pipes, or in a narrow chamber in the centre of each cooling box. The direct application of water to hot char is very injurious.

after an extended series of experiments on a practical scale, he came to the conclusion that in any form of rotating cylinder the amount of waste by attrition is so great as to prove fatal to the process. He therefore adopted a singularly formed kiln, being a combination of a pipe kiln in which the section of the pipes is 30 inches by 1 inch, and a kind of inclined plane, or rather series of steps, on which the char is dried before it passes into the pipes. In this process means are provided for drawing off and utilizing the steam and gases, and the char is introduced and drawn away continuously by self-acting machinery.

In Norman's kiln, recently patented, two cylinders are employed, each set at a slight incline, so as to make the char travel forward, and the char passes from one to the other, and finally out into cooling boxes of the usual construction. As in Gordon's original design, the cylinders are provided with ribs to carry round the charcoal, and means are provided for taking off, but without any attempt at utilizing, the steam and gases. This process works well in practice; does not consume more fuel, apparently, than the upright iron pipe kiln; and makes excellent charcoal,—although, like all other forms of revolving apparatus, it necessarily produces a large quantity of dust. Several of the other forms of cylindrical kilns are very similar in construction, and differ only in minor details. The production of dust does not appear to me to be a serious consideration, as charcoal, in order to be maintained in an efficient condition, requires constant renewal.

In conclusion, I may be permitted to express the hope that means may soon be found to revivify animal charcoal without exposing it to greater heat than is necessary to dry it. It is the process of "burning" which gradually destroys its absorbing powers and makes it "old." There is no difficulty, on the laboratory scale of working, in renewing the original power of charcoal by removing the compounds which have been absorbed from the sugar, and the difficulties in the way of adapting these to the requirements of the refinery are probably not insuperable.

CANE CULTURE IN THE ISLAND OF REUNION.

In No. 10 of *The Sugar Cane* we gave a *resumé* of a report presented to the Reunion Chamber of Agriculture, on the culture and disease of the cane in that island. A further report on the subject, from a different pen, has since been presented to the Chamber. This report contains much interesting information on artificial manures and other subjects, but is too voluminous for literal translation; the substance of the greater part will be found in the following pages:—

Report, &c.

Last year we reported on the preparation of the soil, so that in natural sequence we should now proceed with the planting of the cane, and discuss the important question of choice of plant. But on this head the elements of complete solution are wanting. We find it impossible to base on the facts yet verified an appreciation of the relative values of the varieties of cane, or to advise definitely under the varied circumstances of particular cases whether to keep to the old stock, or to plant new sorts.

We may with less regret leave this subject for the present, inasmuch as it appears to be accepted as a fact, that when submitted to good cultivation, with suitable manure, the canes at present grown will recover all their former vigour; and daily experience proves that however hardy and vigorous the new stocks lately imported may be, that if submitted to the same conditions of culture long enough, the same results follow as in our old stocks of cane. We therefore defer the consideration of the renewal of our stocks of cane and the choice of plant, and return to the improvements needed in our system of culture.

Amongst these improvements, the question of manures is of the first importance. The great law of *restitution* too long unrecognised demands our closest attention; and it is to this, in connection with the culture of the cane, that we shall direct the attention of our agriculturists in the first instance.

How *restitution* has been practised (or rather neglected) since the commencement of the culture of the cane in Reunion, how and

to what extent it is practised at the present time, and how it ought to be carried out, are the divisions of the subject under our consideration.

When a cane cutting, placed in the soil, begins to sprout, it is its own substance which furnishes this first development; a little nitrogenous matter concealed at the base of the shoot (which may be discovered by its bitter taste), the saccharine water, and the mineral substance contained in the cellules; such are the food of the young shoot. Protected by its leaf, nature has provided the bud with an alimentary vessel to supply it during the first days; here is the albumen or cotyledon, and the saccharine solution ($C^{12}H^{11}O^{11}$) which the vegetative force transforms into cellulose, and ligneous tissue ($C^{12}H^{10}O^{10}$) by the simple displacement of an equivalent of water.

But very soon the roots strike into the soil, and the leaves spread themselves in the sun. The young plant, which commences a new life, now demands materials for its development from the two elements in which it is placed—the soil and the air. Carbon, hydrogen and oxygen, nitrogen, and a certain number of mineral substances are all revealed by chemical science as contained in the plant.

The air we know furnishes carbon in the state of carbonic acid in inexhaustible quantity, and nitrogen either in a gaseous form or in ammoniacal compounds. The soil also provides water charged with both these, and it alone furnishes the mineral salts.

We have already strongly insisted on the great fact of agriculture, of entirely modern demonstration, viz., the important part which minerals play in the life of plants. With the knowledge of this fact the true progress of agricultural science commences. No idea could be formed of *restitution* when the necessity of the plant finding certain mineral substances in the soil was entirely unknown; consequently, when the possibility of the soil being exhausted was unrecognised.

In manures, importance was attached only to organic matters more or less modified by their passage through the bodies of animals, and not even a suspicion was entertained of any other.

It was supposed that the soil might become fatigued like an animal too hard worked, and the idea of returning to the soil the debris of the cane and the residues of the manufacture of sugar was never even entertained.

The usual practice amongst us until these last ten years has been somewhat variable. Many of our planters did not prepare manure. Some rejected it systematically; others employed only a small quantity not sufficient to half cover a third of their plantations. The megass ash accumulated uselessly in the corners of their yards, the scum and refuse flowed away as they still do to the nearest stream, the molasses was sent to the distillery, and the lees thence to the river. These various residues contain all the mineral salts which have been absorbed from the soil. What riches have thus been cast into the ocean!

The system of covering the land with wild pea or vetch, though judicious in principle, as practised restored to the soil very little of what it had been deprived. The green crop was never ploughed into the fields. What was expected from it was not that it should supply the soil with nitrogen absorbed from the atmosphere, or with mineral salts drawn by its long tap roots from the subsoil, but that some lucky influence should attend the mere covering of the fields by it, as though the soil, being fatigued, might the better sleep and recover itself by being covered up.

Thus, before the importation of guano, *restitution* was unconsciously practised in a rudimental manner on some few plantations, and neglected everywhere else

We will now inquire as to what our soil has thus lost as regards mineral salts.

According to the latest results of scientific agriculture, the cane plant absorbs from the soil some proportion of ten minerals, all of which have been found in its ashes; but it is only necessary to take account of three of these, the others either being unnecessary for the life of the plant, or existing in inexhaustible quantity in the soil.

Let us see what quantities of these the crop takes from the soil. According to analysis made by M. Dupuis, the composition of new cane is as under:—

Water	72·0
Sugar	17·8
Cellulose	9·8
Salts	.4
	100·0

M. Payen has found :—

Water	71·06
Sugar	18·00
Cellulose, &c.	10·46
Salts and Silica	0·48
	100·00

The following are the results of an analysis we have made with the able assistance of M. Conte.

A fragment of cane weighing exactly 100 grammes, taken from the middle of a red cane, cut on the 30th of May at 2 p.m., was burnt the next day in a crucible for eight hours. The ashes were then placed in a small metal crucible, and kept over a spirit lamp for some time, in order to evaporate the moisture and destroy all organic matter without decomposing the chlorides. When the weight of the ash became constant, it was cooled under a mercurial bell glass provided with a capsule of sulphuric acid, and then placed immediately on a very fine balance. 100 grammes of the fresh leaves of the same cane, were treated in the same manner. The results were as under :—

	Mineral Salts.
Piece of red cane, per 100 grammes	0·485 grms.
Leaves of same cane, per 100 grammes	1,772 ,,

Thus, as is always the case, the leaves were found to contain the larger proportion of mineral salts.

The results of our experiment but slightly varying from the two analyses given above; suppose we fix 0·4 per cent. as the quantity of mineral matter contained in the cane, or 4 grammes per kilogramme. A stool of canes of average size,

including the leaves, was found to weigh 30 kilogrammes, each stool thus contains 120 grammes of mineral salt; and reckoning 1,850 stools of cane to the acre, it appears that a crop of canes takes from the soil about 488lbs. of mineral salts per acre. In order to find what proportion of this weight is represented by the three salts, phosphate, potash, and lime, we will take Mr. Stenhouse's analysis, according to which 100 parts of ash contain—

Phosphoric Acid	6·34
Potash	24·28
Lime	6·69

Pursuing the calculation, then, we find that the cane takes from the soil per acre—

	lbs.
Phosphoric Acid	30·9
Potash	118·5
Lime	32·6
	182

What becomes of these mineral matters after the manufacture of sugar? The sugar, as we have said, is composed only of carbon and water ($C^{12}H^{11}O^{11}$), and is entirely drawn from the rain and the atmosphere; and if nothing but pure sugar were exported we should not send away a particle of the soil of our island.

Where, then, are the salts which the cane has drawn from the soil? 1st. In the ashes [the composition of which is well known]. 2nd. In the molasses, which contain acetate of potash, chloride of potassium, and sulphate of potash in considerable quantity, besides other salts. 3rd. In the scum of defecation which contains phosphate of lime, magnesia, albumen, cellulose, &c., &c. 4th. In the megass, not used for fuel. 5th. In the pen manure, when the cattle are fed more or less on the green cane tops. 6th. In the washing waters and refuse of all sorts. If, after every crop, all these substances had been scrupulously returned to the soil, we should have restored all which it lends to us in the production of sugar, which itself is derived from inexhaustible sources. As was said by Dumas, in the Senate at Paris:—

"The vegetable crops may be divided into two great classes, in the first of which all the elements are derived from the air and pure water only. Sugar, oil, alcohol, &c., belong to this class. The agriculturist who produces them preserves in his soil all its richness if he is careful to restore to it all the residues of their fabrication. The exportation of crops of this nature ought not to impoverish the land on which they are produced."

These words are a heavy reproach to us, who for fifty years have wasted in our molasses, scums, manures, &c., all that our crops have taken from the ground. When we compute the millions of pounds of sugar our island has produced since 1815, and what they have cost us in this way, we cannot be surprised to find that we have systematically promoted the bankruptcy of our soil.*

We are not, certainly, positively culpable for this deplorable waste; we have sinned in ignorance, in common with most agriculturists. Our culpability only dates from the time when we close our eyes to the acknowledged facts of science, and continue knowingly to violate the laws of nature. It is but just to acknowledge that for some years past we have made some progress. The first attempt at *restitution* was made by the use of guano. The soil will at least recover by its use the phosphates it has lost. Unfortunately its phosphates only; and we have formerly shown that this powerful but incomplete agent of fertility, for want of being judiciously employed, has actually only hastened the bankruptcy of our soil. Instead of proving a means of *restitution*, it was a cause of industrial fever, of speculation, of futile illusions, of more complete forgetfulness than ever of the accepted laws of agricultural science. The powerful stimulus of its excess of nitrogen caused the cane to consume more quickly the little mineral richness which was left concealed in the soil, and from that time our soil has produced but sickly plants. Still it is

* From 1815 to 1867 the island exported about 958,000 tons of sugar. Taking the average yield per acre, we find that during that period the cane alone has drawn from the soil over 40,000 tons of potash and phosphates.

evident that the system followed before the introduction of guano, would inevitably have led to the same results, only a little later and more gradually.

Now that it has been fully proved that guano alone is not sufficient to produce canes as abundantly as they grew in former times, most of our proprietors no longer waste their manure, but take more pains in its preparation. Many of them utilise their ashes, and some have returned to their fields the molasses or the lees of distillation. And since M. G. Ville has commenced his mission, and carried out some important experiments, our attention has been closely turned to chemical manures. We are then doing better than formerly, but by no means all that is needful, as we may see by setting down in brief what is required in the way of *restitution*. The first rule which should be resolutely observed, is, that everything should be returned to the soil which rightly belongs to it.

1. All the ashes.

2. All the molasses, either in their natural state, or in the form of spent wash or lees from the distillery.

3. All the scum.

4. All the washing waters, and all other refuse of every kind.

5. Lastly, and most important, all the megass, straw, litter, and manure.

We recommend with confidence the means adopted with success at St. Benoit for collecting and utilising the scum and refuse. It consists in emptying them on to a bed of straw and grass, collected for the purpose near to the cane mill, and intended to absorb the liquids. On each fresh layer of straw, refuse, &c., powdered lime is scattered to destroy the acidity, and assist in the disintegration of the organic matter. In this manner a very valuable manure is obtained.

And *apropos*, let us note the chief defects in the mode of preparing manures now practiced.

1. The manure being uncovered, loses by evaporation a great part of its nitrogen.

2. The liquid manure which drains from it, especially when it

when they are washed by the rain, not being collected, lose the greater part of their soluble and fertilising properties; the rest is of little value.

3. In making manures rancid we commit a great fault. According to experiments made by De Gazzeri, a manure bed exposed to the air for 119 days loses half its weight and half its soluble principles. "By long-continued fermentation," says M. Gasparin, "the manure loses more than half its substance, more than half its soluble principles, and two-thirds of its nitrogen."

We must then prepare our manures better, and use them in a fresher state.

But for what extent of our soil will these various resources suffice? Can we hope, by returning these substances to our fields which have produced them, to restore their fertility? No, and for this reason.

It is that our fields, despoiled during many long years of their incalculable riches, need, in order to produce as large crops as formerly, to have restored to them an excess of the principles which they have lost. On the other hand, there is an inevitable waste in the residues of manufacture. It is needful also to make allowance for the action of the rains.

It is then evident the entire restitution of the residues of manufacture will not suffice to restore the whole extent of our fields to their primitive fertility. Besides, part of these [the megass] having been burnt, the proportion of nitrogen will be insufficient; and if the Muscat pea, for example, has the advantage of drawing nearly all its nitrogen from the air, it is not the case with gramineous plants like the sugar cane, which need to find the greater part of their nitrogen in the soil. Let us hear what is said on this subject by M. G. Ville:—

"Can the same soil be cultivated indefinitely with chemical manures, and always with the same success? I can answer positively, Yes; but on two necessary conditions—

"1. Restore to the soil in the manure more phosphates, more potash, and more lime than the crop has drawn from it.

"2. Restore nearly 50 per cent. of the nitrogen. Why more mineral manures, and less nitrogen? With respect to the phosphate, the potash, and the lime, it is needful that the restitution should exceed what the soil has lost, because it is exclusively from the soil that the plant derives it, and we must not only compare the loss caused by each crop, but allow for the loss resulting from the dissolving action of the rains."

The above applies equally to the residues of the manufacture of sugar, which, chemically, are the typical manure of the cane.

To sum up, having regard to actual circumstances, and relying on practical results, we may estimate that the residues of manufacture of all descriptions will be sufficient to manure nearly half the superficial extent of the crop from which these residues are derived, if we wish to restore to the soil sufficient of the elements of fertility, and supposing that other sources are neglected. And still the addition of a small quantity of nitrogenous matter, guano, or nitrate of potash, sulphate of ammonia, &c., will be indispensable. Perhaps in the first year or two it may need a proportion of phosphate (if guano is not used) and of lime.

We shall in time doubtless be able to extend the benefits of these resources to a greater extent of land. Meanwhile, if we wish to cultivate every year the same extent, how shall we restore the remainder of the land to be planted?

To take crops from the soil without supplying it with any manure, as is still done by many planters, is a heinous practice: economically, because at present the deficit is inevitable under these conditions; morally, because it is to further, without excuse, the profitless ruin of our country, and to incur in the eyes of our posterity a terrible responsibility.

It is then necessary either that we should cease to plant, or that we should supply manure. We thus arrive at the question of supplementary manures.

(To be continued.)

ANALYSES OF ANIMAL CHARCOAL.

By William Arnot, F.C.S.

Having just completed a series of analyses of the working chars of numerous refineries, it has occurred to me that a review of the results obtained might be useful to many of the readers of the *Sugar Cane*.

To avoid confusion I shall select two average samples each from the Clyde, the Mersey, the Thames, and New York. The following are the analyses tabulated :—

Constituents.	Clyde.	Clyde.	Mersey.	Mersey.	Thames	Thames	N. York.	N. York.
Carbon........	12·90	16·35	9·02	8·24	11·40	11·20	10·20	10·45
Phosphates	82·04	77·93	85·44	87·48	80·61	83·80	83·43	84·50
Carbonates	3·23	3·30	3·10	2·00	5·98	3·33	4·76	3·75
Sulphates.......	·27	·29	·42	·58	·92	·14	·17	·27
Oxide of Iron..	·51	·33	·48	·57	·43	·32	·51	·43
Alkaline Salts..	·25	·20	·20	·15	·20	·20	·10	·15
Sand, &c......	·80	1·60	1·34	·98	·46	1·01	·83	·45
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

Several features of interest will be observed on even a casual glance at the above results. The carbon of both the Clyde samples is considerably in excess of the normal proportion in good working chars, while the Mersey samples are both lower than desirable, and, as a rule, these relative circumstances are found to obtain in the char stocks of the two districts. The samples from the New York refineries, although they have been in use for some years, give excellent carbon results, the Thames samples being only a little inferior in that respect. We have thus three distinct classes of refineries—carbon accumulators, carbon losers, and those which contrive to maintain the normal proportion of carbon. Several

circumstances conspire to bring about these different conditions in different localities—an entire difference in the general working of the sugar houses, differences in the quality of the water supplies, and even greater differences in the quantity and mode of applying the washing water. When abundance of water, boiling and free from organic impurities, is used, the increase of carbon will be but trifling, and if, in these circumstances, the reburning be done carelessly there will more likely be a decrease than an increase in that valuable agent. The New York refiners, as a rule, attend with rigorous care to every thing connected with "the health" of their char: as a consequence the original active carbon is retained and the deposit of inactive carbon prevented.

Every refiner must know that the success of his enterprise depends in large measure upon the condition of his working stock of char, and in these circumstances it is surely worth an effort to retain the most active and useful constituent of it in its highest state of efficiency.

The next notable item in the analyses is the CARBONATES, these range from 2 per cent. in one of the Mersey samples, to 6 per cent. in one of those from the Thames. It will be observed however that the differences in this respect are not marked by locality, but are in great measure due to the quality of the sugars refined in the various establishments. With one or two exceptions the carbonates cannot be said to be excessive, moreover they continually fluctuate through one or two per cent. just as the sugars used are more or less acid or more or less charged with lime salts.

The SULPHATES are noteworthy, they differ widely in the different samples, ranging from little more than a tenth to very nearly one per cent. This is a matter of considerable importance, but inasmuch as my notes upon the subject have been tranferred to your pages from the *Chemical News*, I need not enlarge upon the subject now, suffice it to say that sulphates are active enemies of the sugar refiner; the Americans seem alive to this and avoid or get rid of them in some way or other. Some refiners, unwilling to recognise this enemy, use sugars indiscriminately and suffer accordingly in reduced carbon and fermenting syrups.

It appears that even those who do their best cannot prevent the accumulation of IRON in their chars, much however can be done to keep this dangerous agent within reasonable bounds, and if one-half of the injury arising from this source was understood, preventative precautions would be more numerous. Strict cleanliness and thorough systematic painting will go far to keep iron out of the chars and syrups, and will fully repay the expenditure thus involved.

The ALKALINE SALTS serve to indicate the degree to which the process of washing has been carried. Thus it will be observed that the New York samples afford another proof of the care bestowed upon them, the soluble salts being smaller in them than in any of the others.

In point of cleanness—freedom from SAND and other abnormal insoluble substances—the New York samples also contrast favourably with those obtained on this side the Atlantic.

The figures in the table will, no doubt, on careful examination, present other circumstances of interest to reflective minds.

St. Anne's Laboratory, Lasswade, N.B.,
September, 1870.

THE MANUFACTURE OF SUGAR IN AUSTRALIA.

(*From "The Sugar Cane in Australia."*)

THE general results of manufacture come within a very narrow compass—viz., that from one gallon of good juice 1 lb., and from very good juice, 1¼ lbs. of dry sugar should be obtained.

Sugar manufacture may be classed under three heads:—

1. The common process, or boiling by direct fire, cooling, and draining in perforated boxes or barrels.
2. After boiling to syrup (say 30° Baumé), to finish the process in open pans of various kinds, and drain by centrifugals.
3. The use of vacuum pans and centrifugals.

In all cases the juice is expressed by roller mills, the surface velocity of which should not exceed twenty feet a minute, and the juice, after passing through filter trays, goes to the clarifiers. Mr. Davidson, of Port Mackay, says, in a letter to us upon the manufacture of sugar:—"Many schemes which are brought before the public for the better extraction of the juice would never exist if the inventors would but realise the fact of a mass of cane four feet wide, and moving at the rate of twenty feet per minute, being required to produce three and a half to four tons per diem in a working day of twelve hours. It will take all ten men can do to supply such a mill with cane, and carry off the megass, and then they cannot work (feeding up) for more than four hours at a time. A mill of that size cannot be relied on to produce more than 6,000 gallons of juice per diem, taking all stoppages and delays into account; and this, at 2,000 gallons to the ton, is about equal to three tons per day. One is very apt to be deceived by the statements of cane mill manufacturers as to the quantity of sugar their mills can make, they assuming a very great density—viz., 10° Baumé—as the strength of the juice, while the general average—in Queensland, at any rate—has not, I think, exceeded 8° Baumé. Two thousand gallons to the ton is a very good return, and the number of gallons produced in ten working hours would give the average yield of sugar per diem of any mill. One constantly sees it stated that 70 per cent. of juice can be extracted from the cane, and that this has been and can be done cannot be denied; but it refers to juicy plant canes only, and not to the drier ratoons; 60 per cent. to the former, and 55 per cent. to the latter being, I should say, above the average mark. It is a questionable advantage crushing very hard; so much mucus sap and refuse is added to the juice, and the megass becomes a powder unfit for fuel, while the general experience of planters does not point to a proportional increase in sugar to the extra juice obtained. In Java the rollers are often slacked off, and the mills fed up so as to pass a thick stream of canes through, crushing one another; but this requires great attention in feeding. Taking the proportion at 65 per cent., however, and a return of 2,000 gallons to the ton (or 1⅛ lb. to the

gallon), it follows that from 100 lbs. of canes 65 lbs. of juice, or 6·5 gallons, would produce 7·3 lbs. of sugar; or, a yield of from 33 tons of cane, 2·6 tons of sugar would be produced, which must be considered a very high yield indeed from plant canes. Fifteen or sixteen tons of cane to a ton of sugar is the general average. Sulphurous acid, in the shape of acid sulphite of lime, is used in Demerara in the proportion of ·30 to ·36 per cent. at seven deg. Baumé, which is equal to two and a-half gallons of bisulphite per 700 gallons of cane juice, and is an improvement both in preventing fermentation and in improving the color, but is not absolutely necessary. The lime—which should be quick-lime slacked fresh every day with water in the proportion of two pints of water to 1lb. of quick-lime, for the after convenience of measuring out a given weight of lime—is added in the proportion of 1-3000 to 1-5000 by weight of cane juice, and the liquor heated and cracked. This can be done either in clarifiers or in the grand copper; in the latter case, the end coppers are generally double, so that by attending to the dampers the flame can be directed under either of them alternately.

"So far, whatever system may be ultimately adopted, there is no difference to speak of, except in details, such as skimming before or after cracking, boiling in the clarifiers, filtering, &c., any of which can be adopted, if proved to answer economically; but it is very difficult to get the conditions equal in trying experiments, as one part of a field may be better than another, the weather may be finer, and the fuel drier, and the evaporation more rapid one week than another, any of which changes may produce an improvement far exceeding any gain or loss from alterations in the manipulation. The best way of arriving at results is to try different methods in alternate weeks; but even then it is difficult to entirely separate one week's production from another. Do not be led away by the clear appearance of the juice, caused by the introduction of such substances as alum, soda, and potash, as the after effect in the colours is to produce molasses, and make the sugar deliquescent."

After tempering with lime and running the liquor from the clarifiers into the battery, "the process becomes one of evaporation as quickly as possible, either in shallow trays or in the ordinary

cast-iron pans; the scum, as fast as it rises to the surface, being brushed back and skimmed off. It is this scum which keeps rising as the temperature of the boiling point increases, which is the main objection to evaporating the juice under cover, as, however well it may be clarified, additional dirt is thrown up at a high boiling point, which would otherwise remain in the sugar. Whatever form of evaporators is used, a capacity of 6,000 gallons is required for every ton of sugar to be made per diem. In striking sugar from the tache, a man may learn by using a thermometer at first, though the striking point varies according to the quality of the juice; but practice soon enables one to judge by eye. From the coolers the sugar goes to the draining boxes, the first containing sugar and molasses together, equal to one week's work, reckoning 300 gallons to the ton, and the draining boxes holding three weeks' produce at the same rate. Many people say, you ought to make no molasses; but looking at the affair theoretically, 2 lbs. of sugar are held in solution by 1 lb. of cold water, and as concentration can hardly be carried farther than the proportion of 1-10th of water to 9-10ths of sugar at a boiling temperature, on cooling it is obvious that seven parts of sugar will crystallize out, and two parts of sugar will be dissolved in the one part of water, and remain liquid as molasses, and this gives 30 per cent. of molasses theoretically. Anything under 40 per cent. of molasses is considered fair, and sixty gallons per ton of dry sugar, which is equal to 35 per cent., is good. Good molasses, re-boiled in any of the open steam pans or vacuum pans, will give about half its weight of sugar; but common-process molasses is not generally good enough for this. Centrifugal molasses is the best for re-boiling, but in them the loss —*i.e.*. the molasses—on common-process sugar is equal to between 50 and 60 per cent; on sugar made in open pans, from 40 to 50 per cent.; and on vacuum pan sugar, 30 to 40 per cent.

"Juice boiled down to 28° Baumé, and then subsided and filtered, is the syrup which is generally sent to the open pans or vacuum pan. At this density it consists of about half sugar and half water. If struck lower than this it is liable to turn sour on exposure to the air in the open pans, and up to 28° Baumé very little

harm is done in the evaporating pans. These open pans, of which there are plenty of different patterns, all operate on the same principle of keeping down the temperature by evaporation, exposing a large surface to the air at the same time that they are being heated by steam pipes or jackets. They are chiefly useful in giving a better sugar, a larger grain for the centrifugal, and a cleaner molasses for re-boiling. The vacuum pan does the same thing by a more complicated method, but can only be made use of where there is abundance of water for the purpose of condensing the steam evaporated. The vacuum pan molasses can be twice re-boiled, the temperature at which the molasses is re-boiled being kept higher than when the syrup is being worked up; this last is from 160° to 180° Fahrenheit. Molasses must be re-boiled while quite fresh; it cannot be left till after crop. There is no actual saving in fuel in boiling at a low temperature, as the sum of the latent and sensible heats of vapour is approximately the same at any boiling point, and in evaporating by steam there must always be a loss proportional to the length of steam pipe, the power of the engine required to drive pans or air-pumps, and the heating surface."

We have, in previous articles, referred to the valuable fund of information placed at the disposal of sugar makers by Dr. John Shier, the Agricultural Chemist of British Guiana. In a work written specially upon the various methods of treating cane juice, he arrives at conclusions the correctness of which has been fully borne out in the boiling-houses of Australia. He gives in minute detail the leading methods followed on various plantations, commencing with the system of clarifying by cold tempering—a system followed upon a few estates in this country. The juice, as it is run out from the mill, passes through straining-boxes into large copper, iron, or wooden boxes, of which there are generally two or more. When the liquor-box is full, the temper lime, previously slacked with about half a pailful of cane juice, or cold water, is added, and the whole is well stirred with a wooden hoe or paddle. A glassful of the tempered juice is then taken out, and the contents of the liquor-box and of the glass are allowed to subside. After standing

from ten to twenty minutes, the appearance of the liquor in the glass gives some idea of whether the proper amount of lime has been added; but other indications are also looked for during the concentration, such as the facility with which the scum rises, the colour of the cleaned liquor, the colour of the syrup in the tache, the manner in which the syrup drops from the edge of the ladle, the colour and firmness of the sugar, and the readiness with which it parts with its molasses after being potted. In the first instance, however, the indications given by the proof sample must be relied on. Thus, if the sediment has separated into large well-marked flocks, and has settled down on a layer flat on the bottom of the glass, and, moreover, if the supernatant liquor is pretty bright, with little floating haze, and not of a greenish tint, but of a colour resembling Madeira, the quantity of lime is held to be sufficient. If, however, the sediment is inconsiderable, long of settling, or the supernatant liquor greenish and opaque, the want of more lime is indicated, and a further quantity is weighed out and added. Again, if the flocks are large and loose, and settle in a large cloud-like, somewhat conical mass, highest in the middle of the vessel, and the supernatant liquor is dark coloured though clear, too much lime is supposed to have been used, and its quantity is diminished in the next box. It is held also by many, that when the settlement has taken place in the glass, the tempered liquor is ready to be run off from the liquor-box, although this by no means follows, the sample-glass and the box being of very different depths. When at length the sediment has subsided, or when no longer time can be given to it, the liquor is drawn to the grand copper by one or more stop-cocks placed at different distances from the bottom, so that by opening the highest first, the subsiding liquor under it may have more time to deposit sediment. When the first stop-cock ceases to run, the next lower is opened, and so on to the last, which is as near to the bottom as to leave only thick sediment.

Although so very common in practice, Dr. Shier holds that this is the worst of all methods of clarification, if, indeed, it deserves to be called by that name. Some of the leading objections are the following:—

1. At common temperatures no complete separation of coagulum takes place, even in the best cane juice, and more lime is required to produce the necessary effect than at higher temperatures.

2. That according to the quality and condition of the juice, the sediment requires various times to subside, and subsides into various bulks. Hence, at one time part of the sediment is let down with the tempered juice, and at another a portion of the juice, equally good with the rest, is lost for the purpose of making sugar.

3. There is no clear and well-marked rule for judging of the quantity of lime to be used.

4. There is no allowance for unslaked or un-burnt portions of lime.

5. That, being unboiled, the sediment and accompanying juice is not in a fit state for being set up in the liquor.

6. That, except with the best and most mature cane juice, cold tempered liquor cannot be thoroughly cleaned on the wall.

7. That the loss of juice removed with the sediment, and also of the juice and syrup removed with the skimmings, is very large

To this point Dr. Shier has given much attention, both on a large scale and on a small, and he is satisfied that on most estates in his colony (British Guiana), where the method of cold tempering is pursued, not less than 20 per cent. of the whole juice is thus lost for the purpose of making sugar. In some instances he has found it amount to 25 per cent. of the whole.

8. That by this method of clarification it is almost impossible to remove certain solid nitrogenous matters that impair the lustre and brilliancy of the sugar and the transparency of the molasses.

When a portion of such muscovado is dissolved in water, the solution is not merely coloured, but hazy, and the solid matter can be removed by filtration. The presence of this solid matter he has also found to render the sugar liable to mouldiness when kept for any length of time in close vessels, and it also causes mouldiness and fermentation in the molasses.

On the whole, then, the method of cold tempering is so wasteful, rude, and inefficient a process that it ought at once to be abandoned for some better method.

The doctor next examines the "cracking system." This method has many advantages over the former, and, as it is practised on

many estates, requires to be accurately described. It requires the use of two or more clarifiers, of iron or copper. These clarifiers have been made of all manner of shapes—square, round, shallow, deep; sometimes they are built in brickwork and heated by the direct heat of the fire; at others they are heated by steam admitted into jackets, or into a coil of steam-pipe in the bottom of the vessel.

The process is often conducted as follows:—The strained juice is admitted into the clarifier till a sufficient quantity of it is accumulated to prevent any injury by the heat. Fire is then made under the clarifier, and by the time the clarifier is full of liquor, the temperature has risen considerably. The temper-lime is then added and stirred, and the heat is continued. A thick greenish yellow scum soon appears at the surface, and rapidly increases in thickness, changing colour at the same time from exposure to the air. As the temperature approaches the boiling point, numerous minute air-bubbles rise up and form a frothy layer under the thick scum. By-and-bye these air-bubbles force their way at a few points through the dark dirty-looking scum, which soon cracks in several places, and the white frothy bubbles appear in the cracks. When this point has been attained, the heat is immediately withdrawn, and the contents of the clarifier then allowed to rest for from fifteen to thirty minutes or more. Ebullition is carefully avoided, because it would break up the floating scum, and diffuse it through the mass of the liquor. The time allowed for settling depends on a variety of circumstances—the nature of the juice, the proper apportioning of the lime, and the time that can be allowed consistently with getting through with a good day's work. After settling, there is found a layer of coagulum still at the top, and another layer at the bottom, while the great body of the liquor is tolerably bright and transparent, with a wine-tint more or less deep, and with a quantity of minute floccules floating thick in it. If it is hazy from minute, generally diffused, solid particles, the operation is incomplete; and either the heat has not sufficed to clarify, or the lime has not been used in sufficient quantity. After standing as above described, from fifteen to thirty minutes or more, as the

case may be, the clear liquor is run off into the evaporating apparatus; the scum and sediment, with the considerable quantity of juice that invariably accompanies both, is run off to the skimmings-cistern, to be used in setting up liquor for rum.

When the clarifier has either a coil of steam pipe or a steam jacket it is much more manageable, and it is generally so arranged that little loss of time occurs, for as soon as there is enough of liquor in the clarifier to render it safe, the steam is turned on in such measure as to attain the desired temperature by the time the vessel is full of liquor. Fire clarifiers are generally discharged by a stop-cock near the bottom, till the liquor begins to run muddy. Steam clarifiers are discharged by a valve in the bottom in connection with a tube that rises four or six inches above the bottom, so as to disturb the sediment as little as possible.

The method of cracking, although possessing great advantages over cold-tempering, is still liable to many grave objections, the principal of which are the following:—

1. That unless with cane juice of the very finest quality, such as is very rarely seen in this colony (British Guiana), the point of good clarification is not attainable under the boiling point of the juice. The consequence is, that by the cracking process the juice is never properly clarified, even when the time allowed to settle is considerable. It wants the brilliancy and transparency of properly clarified juice, and has minute, light, flowing particles, which it would take a very close filter to remove, and the process of filtration proves extremely slow and unsatisfactory. This finely-divided floating matter is easily seen when a tube or phial, filled with the clarified juice, is examined with the aid of a candle.

2. That juice clarified in this manner throws up a considerable amount of scum during the process of concentration.

3. That from this cause, as well as the quantity of juice that is lost along with the scum of the clarifier and the sediment, there is scarcely less loss of juice than by the method of cold tempering.

4. That the muscovado sugar, although better than that made by the cold tempering process, is not so brilliant, nor is its solution so free from muddiness, as that made from thoroughly clarified juice.

5. That the quantity of lime used is not regulated by a distinct rule or indication; hence, whenever canes of a different character are brought to the mill, more or less sugar is spoiled or deteriorated before the proper quantity can be determined.

A system of clarification by checks and tests is next submitted, which recommends itself to the enquiring sugar boiler by reason of its simplicity. The steps of the process are as follows :—

1. The strained cane juice is passed into a clarifier, and heated so as to boil briskly for five minutes, the scum that has risen to the top being beaten down with a wooden or wicker-work plunger.

2. When boiling, the proper amount of milk of lime, mixed with a proper quantity of clay-batter or gypsum, or whiting-batter, is thrown into the juice, and it is briskly boiled for a few minutes, stirring well and beating down any scum that may rise to the surface. At this stage the juice is tried with a test-paper.

3. The proper indication being obtained, the heat is withdrawn, and the whole contents of the clarifier is run rapidly into a subsiding vessel, and allowed to stand from fifteen to thirty minutes, or as much longer as may be necessary for all the coagulated flocculent matter to subside to the bottom of the vessel.

4. Whenever the subsidence is complete, which may be judged of by taking out a sample in a tube or phial, and examining it against the flame of a candle or a strong light, the clear juice is drawn off in such a manner as not to disturb the sediment.

5. If the subsidence is not perfect—that is to say, if there is the slightest haze arising from solid particles floating in it—these must be got rid of by filtration, and the filtered juice is received in a cistern out of which the evaporating apparatus is supplied, and in which any excess of lime that may have been used in clarification is to be carefully neutralised by sulphuric acid.

This completes the process of clarification, and the juice is then fit for being concentrated in any of the various sorts of evaporating vessels now in use for the purpose; and in boiling down it will not yield a vestige of skimmings.

It is proper now to return and give a particular account of each of the steps of the process, giving such explanations and directions as will enable any one with a little practice to follow out the method.

The Boiling.—This is insisted on, because from innumerable experiments Dr. Shier has found that the clarification is better, and is effected with the use of less lime, than when the clarification is attempted at any lower temperature. When the canes are exactly ripe, of very fine quality, cut in fine weather, when they

have not lodged and rooted, when the immature portion at the top is rejected, together with all rotten or punctured canes, cane juice is sometimes so good that it might be clarified at a lower temperature; but even in the case of such juice the boiling, prior to adding the clarifying materials, has the advantage of getting rid of the coagulated matter by subsidence, and thereby saving a large percentage of juice. With ordinary juice it is not possible to clarify in the best manner except at the boiling point. Dr. Shier prefers round copper clarifiers with steam jackets to any other form, because in these the temperature can be regulated with the greatest ease, and is completely under control. The clarifier should not be filled quite full, but room left to admit of tho contents undergoing a smart ebullition.

(To be continued.)

THE IMPHEE, OR THE PLANTER'S FRIEND.

(From the "Journal of the Agricultural Society of New South Wales.")

In our issue of last month we published some extracts from Henry S. Olcott's work, giving the directions on cultivation, &c., &c., of Imphee and Sorghum in the United States. We also mentioned that a gentleman lately arrived from the island of Bourbon had, at the request of the Scientific Committee of the Agricultural Society, made some experiments on some syrup, extracted from the "Planter's Friend," by the Rev. Edward Holland, in order to ascertain its exact value as a sugar-producing plant.

The success which attended the experiments made by Monsieur Pruche, induced Sir William Macarthur to invite that gentleman to proceed to Camden Park, and there operate on the plant itself. We cannot do better than translate the letter addressed by Monsieur Pruche to Mr. J. Joubert, who was deputed to witness the experiment:—

Sydney, June 13th, 1870.

My Dear Sir,—You have asked me to give you a written account of the experiment we made together at Camden, on the juice of the Planter's

Friend, and also what my opinion is as to the advantages which might be derived from the cultivation of that plant.

I am most happy to comply with your desire, reminding you, however, that we worked with very rough and very imperfect tools, with plants grown in the worst of all seasons, owing to the late heavy rains, floods, &c., causing unusual growth, and that therefore it is not advisable to consider our experiment as truly satisfactory.

On the contrary, I think that under the circumstances our results must be taken as being very much under what they should have been.

I find in the "memo." I took at Camden that 112 lbs. of "Planter's Friend," stripped and put through a common corn mill, gave us 11½ gallons of juice, showing 11½° (Baumé) and 55½ lbs. of bagasse, containing a great deal of juice still, as could be tested by the mere pressure of the hand.

This juice, evaporated on an open fire in a preserving pan, gave us, after clarification, a crystallizable syrup yielding 6¼ lbs. of dry sugar.

From the above very imperfect result it will be easy to estimate the yield of an acre of that plant. The field we cut the canes from showed a very poor crop—12½ tons only.

My utter ignorance of the cost of cultivation and the price of machinery in the colony does not permit me to say whether it would be advantageous to cultivate the sorghum (I include under that name all the varieties of this plant) for the manufacture of sugar only: I leave this to those who have a better knowledge of New South Wales.

I must, however, say that in going into figures you need take into account the value of alcohols and vinegars which can be readily extracted from the residue or uncrystallizable matter, and the bagasse even, after the sugar is extracted from it; all these operations are inexpensive, and must be taken into consideration, as well as the fact that "sorgho" ought here to yield two crops every year.

I will not enter into the question of manufacture: it might lead me into some minute details which, being badly expressed, might be misunderstood. But taking a general view of the matter, let me advise you, if you wish to obtain satisfactory results, not to operate again unless you have a complete and well-organised plant.

The juice of the "sorgho," from its very nature, requires a great deal more *working* than that of the sugar cane, its boiling requires a great deal more watching, and I do not admit that you can reckon upon satisfactory results unless you use steam, in low temperature machines (Wetzel pans).

As to the sugars themselves, I have no hesitation in saying that you will obtain them as good in colour and quality as those extracted from the cane. To do this, however, filtering through animal charcoal will be necessary. The use of monosulphite of lime will also be of good service.

All I have said is necessarily subject to modifications which experience alone can suggest. But there is one point on which I will again call your attention—viz., the necessity of avoiding all imperfect modes of fabrication. Unsatisfactory experiments from imperfect means might cause a failure, which must necessarily postpone the development of a most remunerative industry.

I am quite convinced that the manufacture of sugars from sorgho must ere long add another source of riches to those Providence has already bestowed on Australia. I most heartily hope I may live to see it.

I cannot conclude without requesting you to convey to Sir William Macarthur my sincere thanks for the valuable co-operation he gave us in placing at our disposal all the means he had in his power to make our experiment.

Believe me, &c.,

PRUCHE.

From the contents of this letter, and from other sources, we come to the conclusion that a good average crop of sorghum will yield, under proper management, close upon two tons of sugar! In the districts where the plant thrives, even now, there are steam flour mills which are idle for eight months out of twelve. Their steam power and other appliances could readily be made available for crushing and boiling. The cost of a battery, such as we have seen at Messrs. Russell, and at Mort's Dry Dock, together with one or two "Wetzel pans," would not entail a heavy expenditure.

If, as we are informed, Monsieur Pruche is willing to instruct some one to manage the first manufactory, it remains only for the growers to co-operate and initiate, either in the county of Camden or the Hunter, a new industry, which must inevitably save our farmers from the penury in which the late disastrous season has sunk them. We may state, in conclusion, that the sample of the sugar made by Monsieur Pruche, at Camden, has been left at the rooms of the society, with the secretary, who will afford all further information on this interesting subject.

We are informed that M. Pruche is willing to impart his practical experience to anyone who may be desirous to undertake the manufacture of sugar from the syrup of any of the sorghum varieties. It is to be hoped that some use may be made of his offer,

there being a vast amount of land at Camden and on the Hunter which will yield splendid crops of this plant. The difficulty is not to grow the crop, which matures in five months, but to charm the sugar from the syrup; and it is just at this point the enterprise will fail, if not prosecuted with such knowledge as M. Pruche seems to possess.

SUGAR AS AN INGREDIENT IN STOCK FEEDING.

A noted agriculturist in one of the Northern Counties informs us that he has found sugar a very valuable addition to the other ingredients used by him in stock feeding. To give an idea of the proportion used, he has furnished us with the quantities of different materials in a mixed food, to which after various trials he gives the preference:—

lb.	
56	Cut Hay,
56	Straw,
14	Indian Meal,
14	Bran,
14	Linseed Cake,
7	Raw Sugar.

SUGAR IN THE AUSTRALIAN COLONIES.

Does it Pay?

(From the Sugar Cane in Australia.)

The foregoing will be a leading question (and rightly so) with many who are thinking about venturing into sugar cultivation. It is a question which we approach with much diffidence. It is a question which those engaged in the business are best able to solve; and, fortunately, they have done so to an intelligible extent. The careful reader of the various essays in a previous section of this

work will have very little difficulty in arriving at conclusions regarding the profitableness of this industry. Let the reader remember that the writers are practical workers, who have gone beyond mere theory. We add but two additional contributions upon the pecuniary aspect of the question. The first is the annual report for the season ending April, 1870, of the Maryborough Sugar Company, an extensive concern, worked under the supervision of a manager, in the Mary district. The other embraces calculations made for the beginner upon a small scale by a planter in the Albert district. The small grower can, when he is so disposed, get employment for a few weeks or months, and so help out his, perhaps, insufficient capital.

Directors' Report.

"The directors, thinking that at the termination of the season's crop the shareholders might be desirous of learning the position of the Company, called this special meeting for the purpose of submitting a progress report to the 31st March.

"The season's crop has been good, and has realised as much as the two previous years added together; but owing to the heavy amount required to carry out the necessary improvements and increased cultivation, the Company will not this year be in a position to clear off all liabilities.

"The shareholders are solicited to examine the annexed statement of receipts and expenditure, from which they will learn the largely-increased value of the estate, and the directors do not for the present anticipate the need of any further expenditure, but think that the area of land under cultivation, properly cared for, will be sufficient for the requirements of the Company for some time to come.

"The attention of shareholders is also called to the small amount of capital (paid up) with which the estate has been worked, the capital subscribed being £8,300, but the actual amount of cash received having been only £6,380.

"Robt. Travis, Chairman."

POSITION OF THE M. S. CO. (LIMITED) ON MARCH 31, 1870.

Dr. *Liabilities.*	£	s.	d.	Cr. *Assets.*	£	s.	d.
Outstanding promissory notes	1410	7	6	60 tons of sugar in stock	1800	0	0
Bank overdraft	3760	1	11	55 hhds. of rum in Sydney, at £7..........	385	0	0
Outstanding accounts and wages due	562	9	2	77 ditto on estate and in bond	539	0	0
				Cash credit	3000	0	0
				Deficiency............	8	18	7
	£5732	18	7		£5732	18	7

Dr. RECEIPTS AND EXPENDITURE SINCE JULY 1, 1869. Cr.

	£	s.	d.	£	s.	d.
For sugar sold, 118½ tons	3594	12	8			
Less paid for bagging......	274	13	2			
				3319	19	6
For rum sold, 60 hogsheads	463	9	0			
Less paid for two years' license, casks, &c., and other charges .	196	16	3			
				266	13	9
Increased overdraft at Bank ..				797	17	4
Six shares sold at £30				180	0	0
				£4564	10	7

Wages and rations on following accounts:

Improvements—

	£	s.	d.	£	s.	d.
Huts	135	0	0			
Distiller's cottage	75	0	0			
Store-room and other buildings .	30	0	0			
Land cleared and planted	800	0	0			
Back wages	650	0	0			
Wages for late crop	795	14	8			
Ditto for coming crop	250	4	8			
Passage money, Islanders	97	13	4			
				2833	12	8
Town charges, &c.				86	0	2
Insurance				65	5	0
Still and buildings				714	19	8
Machinery (new)..	149	3	6			
Ditto repairs	172	0	0			
				321	3	6
Implements, &c.				48	13	5
Discount and interest........				219	0	9
Live stock				90	0	0
P.N. current reduced				185	15	5
				£4564	10	7

STATEMENT OF CROP—1869-70.

	£	s.	d.
Sugar made, 180 tons	5119	19	6
Rum made, 195 hogsheads	1140	0	0
	£6252	19	6

The Chairman, in introducing the report, commented on the small "subscribed capital" of the Company, and said that with an actual capital subscribed and borrowed of rather over £9,000, a gross return of over £6,000 had been derived from the estate, leaving balance of profit on year's operations of £2,500.

The adoption of the report having been moved by Mr. Booker and seconded by Mr. G. Mant; on the suggestion of the Chairman the Manager of the Company, Mr. Cummings, gave some particulars respecting the working of the estate, and in reply to the question of a Shareholder, he gave some details of the acreage of cane crushed and the yield of sugar (as under):—

			Tons.
10	acres	all 22-months' plants	30
50	,,	first ratoons	80
20	,,	second ditto	20
15	,,	ribbon	15
8	,,	late December	8
8	,,	ratoons	8
35	,,	ratoons (forest)	10
—			—
146			171

He would observe that the 10 acres had been planted 5 feet by 4 feet, and the other 6 feet by 6 feet; the former had averaged 2,040 plants to the acre, the latter 1,020. They would see that 10 acres of virgin cane had yielded 30 tons of sugar—more than ten times as much per acre as the 35 acres. And this was not all. As he had before observed, the labour of preparing that land and of cultivating the cane was much more expensive than the former. The cane on the bad land required constant trashing, owing in part to the cane not growing densely; but as soon as the cane on good land had reached the height of ten or twelve feet the interlacing of the foliage prevented the growth of weeds, and no further trashing was required. It was the intention of the board, acting on his advice, not to replant this forest land, and there was no necessity for doing so, as they had plenty of good land to cultivate. In

reply to another shareholder, Mr. Cumming said the crop that would be ready for next season's crushing would be—

70	acres	virgin cane
10	,,	first ratoons
75	,,	second and third ditto.
Total 155	acres.	

Besides this, the Company had entered into a contract with the Messrs. Ramsay, of Tinana Creek, to crush 70 acres for them on half terms. As this cane would not be ready until late in the season, it would suit the operations of the Company completely, and this would be all the cane they could crush with the machinery they had at present. He would mention that from his experience a ratoon crop must be off the ground by December to give a fair chance for the next year's cane.

CANE CULTURE IN AUSTRALIA.

The Sugar Planter's Year.

Perhaps the best time to commence operations as a cane grower is in *June*. The temperature is cool then—on the average about 59°. Rains are common, and westerly winds also—a combination which keeps the soil moist and the surface dry. Clearing, stumping, ploughing, and the general preparation of land can be advantageously carried on.

July.—A winter month. Frost is common to the south of the Mary River. Clearing, draining, and general out-door work. Average temperature, 58°; prevailing winds, W. and S.W.

August.—Frosts at beginning; towards the close cane may be planted to the north of Brisbane, and crushing commences. Average temperature, 61°; winds, N.E. and S. Very little rain.

September.—Planting and crushing general. Average temperature, 65°; winds, N.E. and S.E. Light showers.

October.—Crushing and planting. Canes commence to grow,

and active cultivation is necessary to keep the weeds in check. Average temperature, 74°; winds, N.E. and S.W.; thunder showers.

November.—Push on crushing and planting and cultivation of young canes. Average temperature, 74°; winds, N.E. and S.E.; thunder showers. Warm weather. Horse labour employed wherever possible.

December.—Finish crushing, and attend closely to cultivation. Average temperature, 80°; winds, N.E. and S.E.; occasional showers; frequently a dry month.

January.—General cultivation of cane. Planting has been done during this month, but it is generally considered late. Average temperature, 81°; winds, N.E.; frequent thunder showers. At times, a hot dry month.

February.—Summer heat fully felt, and growth of well-cultivated cane very rapid. Average temperature, 82°; wind, S.E.; thunder showers frequent and heavy. Surface drains a necessity to prevent washing of soil.

March.—Temperature begins to fall (average, 76°). Frequent thunder showers and heavy rains call for activity in cultivation. Winds, N.E. and S.E.

April.—Active cultivation to get all the canes beyond their soft stage. Average temperature, 70°; heavy rains common. If a dry season, the rains usually come at this time; effects of floods to be guarded against.

May.—Drainage to be attended to if the land is wet, and general cultivation. Some growers trash the cane at this time. Average temperature, 65°; winds, S. and S.E.; close weather, heavy rain, and fogs. Cane should be nearly full grown, and ripens during the winter.

The westerly winds are dry, gusty, and searching, and shelter from them is desirable. Heavy, cold, gusty storms also come from the same quarter. The other winds are favourable to vegetation. Frosts fall during June, July, and the first week of August, and are most severe during calm, clear nights. The nights during the whole year are cool.

LECTURE

ON THE MANUFACTURE OF BEET-ROOT SUGAR.

A correspondent has favoured us with the following *resumé* (from the Dutch) of a lecture delivered some time ago by Dr. de Loos, before the members of the Association for the Promotion of Industry in the Netherlands :—

In a historical review of the subject, the lecturer observed that the great saccharine richness of the beet-root was discovered in 1747, by Marggrof, an apothecary at Berlin; that several years elapsed before the first beet-root sugar manufactory was built, in Silesia; and that not till the institution of Bonaparte's continental system, in 1806, was it carried out to any extent, at which time many manufactories arose in France, as well as in Germany. The greater number of the German manufactories, however, were at first unsuccessful, and it was only in 1836 that some of them began to revive, and now a large number of manufactories are spread over the greatest part of Europe—Prussia counting about 300, Austria 150, Russia more than 300, France more than 400, and Belgium 100, the quantity of beet-root sugar produced in 1869 in Belgium alone being estimated by Wagner at 500,000 centenaurs: that in the Netherlands, also, the prosperity of the manufactories of beet-root sugar is a matter of much interest: if it cannot be said that they supply a definite want—since a sufficient quantity of sugar is imported from the colonies—they nevertheless find employment for a large number of labourers, in the winter months, just at a time at which, particularly in the rural districts, little work can be got, and they contribute to the animation of trade and manufacture. There are at present seventeen beet-root sugar manufactories in the Netherlands.

This branch of industry, the lecturer continued, rests on a firmer basis now than it formerly did, because the method of preparing the sugar, as well as that of the cultivation of the beet-root, has been considerably improved. The beet-roots are derived from *Beta cicla* and *Beta vulgaris*. The several varieties are distinguished by the form

and the colour of the leaves, and of the roots. To good beet-roots the following, among other, properties are ascribed:—Regular, pear-shaped form; no side roots; weight, from 1 lb. to $1\frac{1}{2}$ lbs. at most; white, firm flesh; small head of leaves; juice rich in saccharine matter, and poor in other substances; the root should not appear above the ground, as the saccharine richness decreases in consequence.

The kinds met with in Germany may, according to Knauer, be distinguished as (1) French, (2) Quidlinburgh, (3) Silesian, (4) Siberian, and (5) Imperials.

The constituents of the flesh of the beet-root may be thus expressed:—

Cellulose and pectose......	4·	4·	(pith)
Soluble substances........	11·5 to	17·	(juice)
Water..................	84·5 ..	79·	
	100	100	

The juice contains crystallizable sugar, albuminous substances, salts of the bases, potash, natron, lime, magnesia, protoxide of iron and of manganese, combined partly with organic acids, as citric and oxalic acid; partly with inorganic acids, as sulphuric acid, phosphoric, and nitric acid; further, chloride of sodium, or common salt, silicic acid, asparagin, an organic base, gum, fat, and a colourless body, which by the action of alkaline bases and of the air passes to a substance containing humus. In the coloured beet-root there is, moreover, a colouring substance as well.

The saccharine richness of the juice varies from 11 to 15 per cent. [say rather from 6 to 12].

In the manufacture of beet-root sugar, fresh beet-roots are principally used, which are first well *washed* with water. In most manufactories they are reduced by grinding to a pulp, which is then squeezed out by means of hydraulic presses. For this purpose the pulp is put into cloths or canvas bags, piled on one another, a tin plate being placed between each two. By this means 87 per

cent. of juice is obtained, so that 13 per cent. is lost. The residue of the pith is called *pulp*, and is used for feeding cattle.

Some manufacturers separate the juice from the pulp by centrifugal machines, which are not so effective as presses, therefore fine jets of water are passed through, to wash out the juice still remaining.

Lastly, there are manufactories in which the juice is extracted from the pulp by water (the maceration process of Schüzenbach), and another mode of operation—the diffusion process of Jules Robert, at Seelowitz (which Dr. de Loos described at some length). It is said by many of its advocates that this diffusion system yields more sugar, whereas the costs of production are much less than that in which the draining is effected by hydraulic presses; on account of the saving in labour.

After the juice has in one way or another been extracted from the beet-roots, it is gradually heated almost to boiling, in the separating pans, with the addition of lime water, by means of steam; then the steam cock is shut, and the mass becomes separated into two layers—viz., one of a thick, greyish scum, on the surface, and under it one of clear juice, which may be drawn off by means of a syphon. The juice still remaining in the scum is drained off, and the residue used as manure. By this operation the albumen is coagulated, the lime combines with organic acids, and with phosphoric acid; several bases, such as protoxide of iron and manganese, are precipitated, and the asparagin, as well as a portion of the albumen, decomposed by the lime. The sugar, in combination with the lime, remains in the juice in solution. The operation of free acids must be stopped as quickly as possible, since organic, as well as inorganic acids change the sugar into uncrystallizable *inverted sugar* (a mixture of glucose and levulose). Albumen also produces a similar effect.

Then the lime must be removed from the clear fluid; for that purpose many substances have been recommended, such as carbonic acid, caseine ammonia, soap oleic acid, stearic acid, silicate of potash, phosphoric acid, phosphate of ammonia, carbonate of ammonia, &c. Almost universally, however, use is made of carbonic acid, and this

operation is called the *carbonatation*. Carbonic acid is obtained in most manufactories by the burning of limestones in kilns, so that the lime required is produced at the same time as an extra production. The gas comes first in contact with a fine stream of cold water, by which it is cooled and purified, and is then pumped into the liquor, so that a sediment of carbonate of lime is formed, and at the same time nitrogenous substances and colouring matter are separated. The viscous mass, which separates in the carbonatation, is generally drained with the scum, the residues being used as manure.

The carbonatation is followed by the filtration. For this purpose granulated animal charcoal is used, which removes the free alkalies—combinations of alkalies with organic acids, the small quantity of colouring matter, as well as some lime. Then the juice is evaporated till it reaches the density of 50° of the areometer of Brix; the juice of a less density is called thin juice, opposed to the further evaporated juice, which is called thick juice. The juice of 50° density is once more filtered through animal charcoal. Formerly the evaporation was effected over the open fire; more recently steam was introduced by Halette as a means of heating. The happy thought of employing the steam generated to evaporate another portion of the juice occurred to Rillieux. An apparatus founded on this principle was introduced by Tischbein; Robert changed the horizontal evaporating pans for vertical ones, and caused the steam to circulate, not *through*, but *between* the pipes filled with thin juice. The evaporation coppers, in most manufactories, agree in principle with those of Robert's apparatus.

After the second filtration through animal charcoal the thick juice is *boiled again*. To evaporate at as low a rate as possible, and to prevent, as much as possible, the passage into uncrystallizable sugar, vacuum pans are used. In reboiling in the vacuum pans, the liquor is boiled till the sugar crystals in it may be easily felt between the fingers.

If the liquor is then drawn off from the copper it will, on cooling, yield either raw or loaf sugar, according to the temperature it is at on leaving the copper. If the temperature is about 82° of

Celsius, loaf sugar is obtained. The raw sugar is generally allowed to crystallize in pans; the loaf sugar in sugar moulds. The raw sugar obtained by the first crystallization is called the *first* product; by evaporating the syrup the *second* product is obtained; by continued evaporation the *third* and sometimes a *fourth* product is obtained.

The loaf sugar prepared from the juice of the beet root, is called *sap melis*, to distinguish it from the *melis* of refined sugar. Formerly, it was not possible to get the *sap melis* of sufficient hardness and density, so that it was pronounced less sweet than the ordinary *melis;* at present, however, as well by the boiling till the sugar crystals may be easily felt between the fingers, as by the addition of fluids containing sugar, the *sap melis* may be obtained just as hard and as dense as the ordinary *melis*.

After the loaf sugar has been allowed to drain, the syrup remaining in it is removed by pouring a solution of quite colorless sugar upon it, this is called the "covering" of the sugar; the loaves at first dark colored, by the "covering" become white. They are then freed from the juice remaining in them by the pressure of air, and they are at last dried in stoves.

The sugar-syrup, which after the crystallization of the *third* or *fourth* product, yields no more crystallizable sugar by evaporation, is called beet root molasses. It has a very disagreeable taste, so that it is not adapted for sweetening. It is used as fodder for cows and sheep, for which, it is usually mixed with oil cakes of various kinds; it may also be used in making beet root spirits; from the residue, sulphate of potash, chloride of potash, carbonate of potash, and common soda may be prepared.

In conclusion some remarks were made on sugar refining, the lecturer stating that few establishments in the Netherlands work up colonial sugar exclusively, by far the greater number using beet root sugar as well.

THE WAR AND THE BEET-ROOT SUGAR CROP.

Paris being closely invested by the German armies, the latest number of the *Journal des Fabricants de Sucre* which we have received is that dated the 8th of September, and no copy of *La Sucrerie Indigène* has reached us during the month, so that our intelligence regarding the beet crop in France is not very recent. With respect to the amount of damage to the growing crop done by the invading armies, and the hindrance to its manufacture in other parts of the country by the "levy *en masse*," we can do little more than surmise. From the *Journal des Fabricants* of the beginning of September we translate the following view of the situation at that period, since which time it has become in every respect more gloomy:—

"How can we write an article on the subject which our professional duty calls for when from the windows of our office we see at every instant the march of regiments, and the air resounds continually with the noise of the trumpet and the drum? The chant of the 'Marseillaise' scarcely accords with a *bulletin* dedicated to the cane or the beet-root, and it needs considerable powers of abstraction to think of anything else than what occupies all hearts: the safety of our beloved country. In the face of so many engines of destruction, of which we see the incessant defile, we are involuntarily led to other scenes, and think sadly of those magnificent instruments of industrial production which will be destroyed or paralysed by the war. At the present time some of our finest sugar manufactories—those of Rethel, Alligny-et-Vouziers (Ardennes)—are the centre of the operations of the contending armies, which, whether friends or enemies, will not fail to make use of them when necessary. All this is profoundly sad, and we have no other consolation than the thought that by the immense sacrifice of human life and the great destruction of property we shall be inspired with a salutary horror of the scourge which engenders all these evils.

"The sugar industry happily has seldom witnessed events of this

character, and their consequences it has yet to prove. So far the damage it has suffered is limited, and at present the most important of our sugar departments appear to have little or nothing to fear. The sugar trade, then, need not fear any want of supply, nor any special circumstances in addition to the crisis, which it submits to in consequence of the general interruption in business. It does not come all at once, as in 1848, when, in consequence of the abolition of slavery in our colonies, the imports of sugar fell from 100 millions to 57 millions, whilst the deficit in the beet crop was 16 millions, this deficiency being the more important as there was then a *surtaxe* of 20 francs per 100 kilogrammes on foreign sugars. To-day a similar deficiency (in the present state of our foreign customs relations) would have little effect. Besides, sugars are declining, and it will only be needful to wait, if the war is prolonged, to see the beet-root offered [by the growers] to the manufacturers at a very low price. * * * * The crop continues to enjoy the most favourable conditions of temperature. In *le Nord* and *le Bas-de-Calais*, especially, the beet-root is remarkably fine, and if, as is supposed, the war will not be carried into these rich sugar districts, no doubt the manufacture will be commenced at the usual time. Labourers, in consequence of the stagnation in other industries, will not be wanting, and besides, workmen from Belgium will come as in preceding years.

"Never was the sugar campaign opened with apparatus so perfect and means of production so great. Besides fifteen new factories, all supplied with the newest apparatus for the manufacture of white sugar, considerable alterations have been made in a great number of *usines*, with a view of improving and increasing their manufacture of the beet. The greatest activity has prevailed in the establishments in the north, where machinery for the manufacture of sugar is produced, and we can only greatly deplore the effect of the war which has come to hinder this increase of industrial activity, so profitable to the country."

The growing beet crop in France would have produced 300,000 tons of sugar, *i.e.*, if it had not been damaged by the invaders, and had been gathered and manufactured under favorable circum-

stances. There is no question but that very considerable deduction must be made from this estimate now that the country is to large an extent in possession of the enemy. On the other hand, it is equally unquestionable that the consumption of sugar will be greatly decreased, as it is more an article of luxury than of food in that country. We hear that some of the beet sugar manufacturers in the northern parts of France are endeavouring to make arrangements for the storage in London of the whole of their October production, and several consignments of colonial sugar from Havre have already arrived in England. Should any considerable quantity be thus thrown on our market in addition to the ordinary supply considerable depression will no doubt be the result.

The estimated yield of beet sugar in all the other continental countries is considerably above that of last year, as will be seen from a table extracted from *Licht's Monthly Circular*, which we give in another part of our impression, and there is no doubt but that workmen will be forthcoming for its manufacture. It appears, then, that making *considerable* allowance for damage to the crop and difficulty of manufacture in France, that the yield of beet-root sugar on the continent of Europe in the ensuing season will probably equal that of last, which it will be remembered was larger, by 170,000 tons, than that of any previous year.

DEMERARA.

(From the Royal Gazette.)

The war between France and Prussia has created some alarm in this colony with respect to a probable increase in the price of provisions. It is feared that, even if England keep aloof from the struggle, prices will rise, but the great evil to be deprecated is a war between England and the United States, as, apart from the disastrous consequences to both countries, the inhabitants of this and other British colonies would be severe sufferers. Unfortunately for us we must import flour, corn, cornmeal, salt provisions, and a great many other articles of food from the United States, and if the supply were cut off, as it would be by a war, the result would be serious. It is to a great extent our own fault that the risk is incurred, as many of the articles imported can be produced here and of a superior quality. For instance, rice grown here is better even than that of Carolina; our corn is much finer and so of course must the meal be: peas and beans grow rapidly, and if our farmers could be induced to labour steadily and turn their lands to good account we might dispense with many articles now imported. If they be wise they will lose no time in planting green provisions, such as tannias, cassava, yams, peas, beans, rice and other articles of food and they would probably find themselves amply rewarded for their trouble and labour. We fear, however, that there is little or no prospect of any such action being taken, for it is notorious that numbers of our creoles who own land, so persistently neglect its cultivation that they are glad to purchase provisions, which they could themselves raise with facility, from the African and Portuguese farmers. Arrowroot and tous-le-mois might be produced in abundance, as the plants might be said to grow wild, but capitalists invest their money only in sugar estates, and persons of less means are afraid to speculate. The consequence is that with the ability to raise our own supplies we are dependent for almost everything upon foreign imports. But for the Portuguese and African farmers, who cultivate only on a comparatively small scale, the town market would be poorly supplied and the price of green provisions would be exorbitant.

BARBADOES.

(*From the West Indian.*)

We continue to have sultry weather, with southerly winds and overhead rains. On Monday there was a heavy rain over the north end of the island and extending over St. Thomas and the Cliff, coming up from the northward and westward, and similar occurrences since. In other parts there is rather a want of rain, as it falls partially though heavily. A very fine crop of Indian corn has been reaped, the more valuable on account of the high price of American breadstuffs, owing to the falling off of the importation and to the war. Potatoes also are coming into the market, selling at 8lbs. to the bit, although the worms have destroyed the vines on several estates in this parish, and are said to be extending their ravages into St. George and St. Philip. The cane crop continues to look well; and on the whole we have every reason to be satisfied with the condition of the crops and the appearance of the country. We have now had three months of favourable weather, with an average rainfall of 4 or 5 inches in August, 5 or 6 inches in July, and 7 to 10 in June; with equally favourable weather for the remainder of the year, there is every prospect of our reaping a good crop of yams and other provisions and as large a crop of sugar as has ever been shipped. We hear the canes are particularly fine below Cliff and in St. Philip and Christ Church. On the Cliff they are not so forward, but are not thought the worse for that. The preparations for next year are forward, and we need not say well made in respect of tillage, for which labour has not been spared, and the weather has been favourable. Steam mills are being put up at Haggatt Hall and the Valley in St. George's. The shipments of the last crop amount to 32,019 hhds., 2812 trcs., 9905 brls., 20,730 bags, equal to 37,724 hhds. of sugar, and 16,666 puns., 723 hhds., 538 brls. molasses, which may be taken for the total shipment, less one or two hundred hhds. of sugar and as many puncheons of molasses awaiting the arrival of vessels to take them.

These have fallen off owing to the closing up of our shipments and the season of the year, and no doubt in part to the war, which draws away freight from the West India trade to supply the place of vessels from Bremen and Hamburg and other German ports.

THE SIZE OF ESTATES IN REUNION.

(*From the Moniteur de la Reunion.*)

The exaggerated extension of the size of estates produces effects not less disastrous than their extreme subdivision. It is no doubt possible to instance in the island some proprietors who are able to manage their vast domains properly; but that these are only exceptions which will not serve as a general rule, what is passing under our eyes is sufficient proof. Properties badly managed, which do not produce what they ought, in consequence of the relative want of resources at the disposal of the occupant, and of insufficient attention given to cultivation—such properties are evidently constituted on too large a scale. This is one of the most untoward consequences which have resulted from the extraordinary returns which for a while we obtained from the cane, and of the unlimited credit which followed. It is essential that we should not undertake more than we are able to carry out satisfactorily. The pauperism which is beginning to make itself felt among us has arisen from our having pursued a directly opposite course. All the small heritages have been absorbed. So long as what we very improperly called our prosperity lasted the evil was but slightly felt. A host of small offices was created, which were supported by the great and unparalleled industry to which the country was devoted. But the evil days have come, expenses have *per force* been reduced; it has been necessary to discharge a great number of *employées* and servants—the class who, having sold the bit of land by which they lived, are to-day found, with their families, without resources, and form a class of veritable *proletaires*.

Their only refuge is agricultural labour. But here the necessity of a new organisation is apparent. The creole is naturally proud, imbued with prejudices born of slavery against all regular work. He will not then submit to agricultural labour so long as he is able to maintain the show of liberty. Is it not this which actuates all those who have retired into the interior of the island, where degrading labour does not repel them?

Thus, improvements in our modes of culture, the reconstitution of small properties, and the transformation of our present system of manufacture—such are, we think, the principal remedies on which depend our gradual recovery from the present precarious situation into which we have fallen.

Correspondence.

To the Editor of the Sugar Cane.

Sir,

In the October number of *The Sugar Cane* for last year you published a statement of the crops of some estates in Antigua, in which the quantity of sugar made from a given number of gallons of juice was compared with the weight of concrete obtained from equal quantities of juice, the average yield per gallon, when made into muscovado, being about 1 lb., and of concrete about $1\frac{8}{10}$ lbs.

I have had the opportunity this week of spending several hours in a refinery turning out about 400 tons per week, and was shown some samples of low concrete that had been bought at 16s. 6d. in bond. They were the worst samples of concrete I ever saw, but even then it seems clear that so low a quality is more profitable than higher-priced muscovado, on account of the large quantity obtained.

The difference in price between the samples shown and good muscovado was said to be £5 per ton. Let us see what values

equal numbers of gallons of juice would give when made into concrete and into muscovado.

To make a ton of sugar would require, as stated above, taking the average of last year's crop in Antigua, 2,240 gallons, and these would yield in cash in Liverpool £21 10s.; 2,240 gallons made into concrete, average as above, would yield 1 ton 18 cwt., which, at £16 10s. per ton, is £29 14s., so that even at so low a price the concrete is much more remunerative than the muscovado. When the nett value of the molasses is added to the sugar, the difference is still decidedly in favour of the concrete, and this difference is much increased when *average* concrete is compared with average muscovado.

The difficulty complained of—viz., that the concrete sometimes comes in such hard masses as to be unmanageable, is easily got rid of by a plan I saw in the refinery named above—viz., an adaptation of the bark mill used by tanners, and an exact duplicate of the machine used in Montserrat for cutting the limes, previous to pressing them.

This machine will make short work of the hardest concrete, and entirely removes the objection named; it is not more expensive, either to make or to work, than the ordinary rollers used over the blowing-up pans.

These considerations may have weight with some of your readers, and it seems much more reasonable to try to make the best of the concrete, than to go on with the old plan of open coppers, with their waste and dirt.

Yours truly,

Sept. 22nd, 1870. W. J. BLACKBURN.

NOTICES OF BOOKS.

Four Years in Queensland. By E. B. Kennedy. London: Edward Stanford, 6 and 7, Charing Cross, London.

Respecting the object of this work, the author states that he has so often been asked questions by friends at home about the country of Queensland—its life, climate, soil, &c., that he has been induced to embody the results of his experience in a volume, with regard to which he wishes it to be understood that he has endeavoured to present matters as they really are, and to describe things just as they appeared to him during a four years' residence in the colony, "without any attempt at scientific writing, or more than touching upon the politics of the colony."

In carrying out the end he had in view, the author has produced a very useful book—one which intending emigrants to Queensland will do well to read, more especially if belonging to the classes for whom the author chiefly writes. It may also be useful in deterrihg some from emigrating who would be better at home. "The book is chiefly written, says the author, for those who possess a moderate capital, have no profession, do not wish to swamp the whole of their capital at home in a farm, or anything else; while *steady*, are yet imbued with a spirit of adventure, who would be proud to help in opening up a new country—to feel, when most of the hardships are over, and they are commencing to reap the fruit of their labours, that they were among the first pioneers!"

"My remarks," he continues, "will also apply to the labouring classes. Of course a man with a large capital will nearly always get on, or it is his own fault; and I *have* known cases where men have done well with no capital at all. But let no one get an idea into his head that he is going to make a fortune in a short time. I cannot imagine how so many lies ever got home, for I know that persons used to start with the inward belief that they were going to realise a fortune in a few years; and emigrant girls, as they

have often allowed, left with the full conviction that they were sure to marry a 'rich squatter.' As money, we know, makes money, I believe fully that a large capital, judiciously laid out in the growth and manufacture of sugar cane, would in a very few years bring in a handsome fortune; but in no other case connected with agriculture is it likely that a rapid fortune could be made. If a man would not be satisfied with making a comfortable home, everything his own, no rents or taxes to pay, and very likely getting good interest for his money, but not *at once*, he had much better not come out."

Mr. Kennedy describes at length the physical features, the natural history, the botany and the agriculture, the mineral wealth, &c., of the colony, in a plain and interesting style. The sugar culture, as we have seen, he considers as the most profitable enterprise, not only because the climate and the nature of the soil are favourable to it, but because the colony has advantages over many countries where the sugar cane is the staple growth. Notwithstanding the richness of soil and the favourable climate, we learn that tropical agriculture has been but little practised in Queensland until within the last few years. On this head, Mr. Kennedy, commencing a chapter with an obvious truism, observes:—

"No country ever yet attained to greatness that did not interest herself in agriculture; yet the very fact of mentioning this word in connection with the colony of Queensland, four or five years ago, would have called forth a derisive laugh from most men. It is true that wheat and other cereals, together with a few fruits, have been grown successfully for many years in the southern parts of the colony; but as for sugar, cotton, maize, &c., being cultivated, it was a thing unheard of, and we have to thank such men as Captain Hope, and a few other pioneers in sugar cultivation, for proving, at great expense and labour, that it is by these tropical productions that Queensland will, before long, attain such importance, and will take a position before the older sugar-producing countries, such as the West Indies and Mauritius. This is no idle boast, but based upon facts, as anyone may judge for himself by visiting the various plantations of the colony. Our earlier

planters, together with some of our squatters, have all along foreseen the great wealth which must accrue to the colony, whenever its very rich lands were cultivated. Working men and others certainly made attempts to farm on a small scale, but the land laws of those times (some few years ago) and the state of the country generally crippled them. The great agricultural districts round Warwick, Zoowoomba, &c., have been growing wheat and other cereals, together with fruits adapted for this more southern clime, for some years, and most successfully, too; but it is more particularly upon tropical productions that the future agricultural prospects of the colony will depend. This will be the more readily understood when it is stated that extensive districts here and along the whole line of seaboard from Moreton Bay to the far north are peculiarly adapted for agriculture generally, and for producing sugar and maize in particular. Districts formed of the richest black soil plains, and alluvial deposits along the banks of ever-running rivers; these coast districts are visited by regular rains, and have been *proved* by experienced planters, and the result has by far exceeded their expectations."

"Look what other countries have done, and are doing, and why is Queensland not to do the same? Yes, and better; for, so far, no disease of any description has attacked the canes; they grow better than in the West Indies, not only as to size and yield of saccharine matter, but also because canes will 'ratoon' well in Queensland that never would in the West Indies."

"The Mauritius has applied to Queensland for canes. We have a certain market for sugar on the spot for years to come, at high prices; the consumption of the 100,000 people, chiefly owing to the quantities taken at the stations, where so much tea is drunk, will keep up the local market for a long time."

We may add that when the production exceeds the consumption, the demand from the other Australian colonies, at present chiefly supplied from Mauritius, is very large. The Queensland colonists appear to be alive to all these advantages, as well as to the cheapness of cattle, coals, and provisions; and the scientific culture and manu-

facture of sugar is being pushed with a zeal that many older colonies would do well to imitate.

Mr. Kennedy concludes his book by a very useful digest of the New Land Act, the provisions of which appear to be of a very liberal character, and a great improvement on the old regulations, as well as in advance of those of other of the Australian colonies.

In conclusion, we have pleasure in recommending this book to all who are interested in Queensland, or in emigration generally. It contains an excellent map of the colony, on a comparatively large scale, with all the latest discoveries.

NEW PATENT.—FROM THE MECHANICS' MAGAZINE.

415. A. Herbst, Moscow. *Drying sugar.* Dated February 11, 1870. This consists of a cylinder provided with tubes, and heated by means of waste steam; the air, as it passes through the tubes, has its temperature raised to any degree. The temperature is regulated by the aid of a thermometer, arranged at the point where the air leaves the heating apparatus to enter the tube. The air, before it enters the heating apparatus, may be passed over a layer of chloride of calcium to dry it. But this is not absolutely necessary, as the sugar may be dried in twenty-four hours when the air is not conducted above chloride of calcium. As soon as the air thus warmed passes into the moulds, it is subdivided into many currents, and diffused through the crystals of sugar, absorbing the moisture, and passing away at the bottom of the loaves.

ESTIMATED YIELD OF BEET-ROOT SUGAR ON THE CONTINENT OF EUROPE, FOR THE SEASON, 1870-71, COMPARED WITH THREE PREVIOUS SEASONS.

(From Licht's Monthly Circular.)

	1870-1. Tons.	1869-70. Tons.	1868-69. Tons.	1867-68. Tons.
France	300,000	285,000	213,954	229,767
Germany (Zollverein)	225,000	215,000	208,140	165,014
Austria	130,000	112,500	76,201	193,051
Russia	115,000	100,000	65,000	97,500
Belgium	50,000	45,000	37,578	31,039
Poland and Sweden	40,000	32,500	21,500	15,000
Holland	15,000	12,500	10,000	7,500
Total	875,000	802,500	632,823	638,871

As will be supposed, Messrs. Licht & Co. make little or no allowance in the estimate of the yield of the coming season for the great damage done to the beet crop in France by the German armies, which, as they have swept over an extensive beet-root district, must be considerable, neither do they allow for deficiency of labour to work the crop either in France or Germany; their calculations are based on the breadth of beet root sown and the state of the crop.

STOCKS OF RAW SUGAR IN THE CHIEF MARKETS OF THE WORLD, TO THE END OF JULY, IN THOUSANDS OF TONS, REFINED AND MOLASSES BEING REDUCED TO RAW.

United Kingdom	180	117
France	56	44
Holland	50	53
United States	146	156
Zollverein	4	5
Havanna & Matanzas on 20th Aug.	66	72
TOTAL	502	447

Exports from Havanna and Matanzas from January 1st to August 20th, 1870, in thousands of tons.

	1870.	1869.	1868.
Great Britain	157	138	160
United States	155	162	138
Northern Europe	9	9	16
France	44	45	39
Spain	55	42	43
Southern Europe	3	2	3
Other Ports	8	6	7
	439	403	405
Stock in Havanna and Matanzas	66	72	78

Shipment of Sugar from Mauritius.

	1869-70.	1868-69.	1867-68.
United Kingdom	38,218	21,758	51,930
France	11,155	5,279	1,655
New Zealand	3,633	2,564	....
Australia	45,657	32,952	34,575
Cape of Good Hope	2,245	841	1,906
Bombay	29,492	13,450	25,751
Other Ports	1,258	778	679
	131,658	77,622	116,496

Consumption in Europe and United States, for Years ending July 31st.

	1870.	1869.	1868.
Europe	1,836	1,230	1,868
United States	467	401	407
	1,803	1,631	1,575

SUGAR STATISTICS—GREAT BRITAIN.

To 17th Sept., 1870 and 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	46	4	3	24	77	37	93	15	8	44	161	140	56	12	7	20	95	136
British East India	11	2	..	..	13	9	6	2	..	..	8	14	9	3	..	..	12	14
Mauritius	5	1	..	..	6	3	14	3	7	5	29	16	12	2	9	5	28	20
Cuba	6	6	4	20	36	39	10	16	30	80	136	96	13	14	25	67	120	78
Porto Rico, &c. ..	4	5	1	2	12	6	7	20	1	5	33	15	5	16	1	4	26	13
Manilla & Java ..	30	13	..	..	43	46	15	14	3	3	35	40	21	9	3	4	37	34
Brazil	..	19	1	6	26	19	1	40	3	15	60	55	1	29	4	12	45	57
Beetroot, &c.	1	..	..	1	2	2	15	6	3	14	38	25	16	7	3	17	44	26
Total, 1870 ..	103	50	9	53	215	160	160	117	56	167	500	401	133	92	52	130	407	378
Total, 1869 ..	81	35	5	39	Increase55		146	81	49	125	Increase99		137	82	49	110	Increase29	

STATE AND PROSPECTS OF THE SUGAR MARKET.

The extraordinary events which happened in France during the early part of the month had for a time a depressing effect on the sugar market; but towards the middle of the month a considerable business was done in most descriptions of raw sugars, the demand from refiners being very large. This, and the hopes of the speedy restoration of peace which then prevailed, gave a firm tone to the market, and although these hopes have since proved futile, prices have remained steady.

Imports have slightly increased during the month and are up to the present time about 100,000 tons in excess of the same period in 1869. It is satisfactory to note that deliveries also appear steadily to increase, being nearly 30,000 tons more than during the first nine months of last year.

No. 12 Havana afloat is quoted at 27s. 6d. in London, being 1s. 3d. per cwt. less than at the same date in 1869; whilst fair to good Bahia and good to fine Pernambucco are on the average 6s. per cwt. less than last year's prices at the same date.

With the exception of Reunion and Mauritius, accounts of the next season's cane crops are generally good and as only a small proportion of the sugar from these islands reaches this country, the expected deficiency in their crops will not perceptibly affect our market. The continuance of the insurrection in Cuba and the destruction of property which is caused thereby must have some effect on the sugar production of that important source of supply, but to what extent we have no reliable data by which to judge.

Large quantities of colonial sugar are being transferred from French ports to this country, and as some manufacturers of beet sugar in the northern departments are making arrangements for storing the whole of their production for the month of October in London, stocks will be still further increased. On the other hand, it is said to be part of the Prussian plan of campaign to visit with their armies many of the departments of France, so that the more important beet-growing districts may not, as was hoped, escape; still, the estimated yield of the other continental countries is so large, that, making allowance for considerable damage being done to the beet in France, it is still probable that the total amount of sugar produced in Europe will be fully equal to that of last year.

☞ *Communications and Advertisements to be addressed to the Editor of "The Sugar Cane," Galt & Co., Publishers, Manchester.*

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☞ The writers alone are responsible for their statements.

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PRACTICAL OBSERVATIONS ON CANE MANURE.—No. VI.

By Dr. T. L. Phipson, F.C.S.

(*Late of the University of Brussels, Professor of Analytical Chemistry.*)

Since my last paper on this subject, which appeared in the August number of *The Sugar Cane*, I have collected some further observations. The delay which has occurred, and may perhaps again occur, in these communications has a double cause. In the first place these elementary facts connected with the science of the soil are jotted down in my leisure hours, and these, of late, have been "few and far between." In the next, it is not easy to write upon a subject which deserves much thought, when the attention is constantly drawn to the murderous warfare which is devastating an adjacent country.

The analyses which I now possess of the cane soils of various West India islands, and of the continent of British Guiana, present numerous and important differences. Some of these soils contain much more lime than others; some are rather richer than others in phosphoric acid. Others, again, have lost a large amount of their *humus*, or "vegetable mould:" and in many the alkalies are nearly gone. A knowledge of the exact composition of a soil at a

depth of a foot from the surface gives, of course, certain facilities in prescribing the most economical methods of manuring this soil for cane (or rather, *sugar*) culture. But one thing has struck me rather forcibly; it is this. As soon as a soil which has been long cultivated, either in canes, coffee, or plantains, begins to get fatigued, and to yield a little less sugar each successive season—in spite of every care—it will generally be found that this soil has become acid. When I made this discovery, it gave me the key to a host of failures, and more especially to the want of success attending the use of superphosphate *per se* upon these partially exhausted and acid soils. This superphosphate merely increases the acidity of the soil, which is already considerable. When a certain quantity of blue litmus water is placed over 4 or 5 lbs. of soil, and allowed to remain some four-and-twenty hours, with occasional stirring, it will be found to have become red, and the quantity of acid present may be judged of by causing the solution to come back again to its original blue tint, by carefully adding a standard solution of soda. I have found that, in several cases, this acidity of the soil corresponded to a deficiency of lime; but in others it did not. For instance, a soil which had grown plantains for 30 years, and canes for 25, was very acid, though it still contained 1½ per cent. of lime, and had been frequently manured with sulphate of ammonia of late years. Its crops of sugar had gradually diminished for the last five years.

If a sugar planter walking through one of his estates in Demerara with a few slips of blue litmus paper in his hand, rubs them over the clay he turns up at a depth of 6 to 8 inches from the surface, and finds that the paper turns vividly red, he may rest assured that his crops of sugar are on the decrease.

This state of things may be rectified by a judicious use of lime. But it must be used with much caution, a little now and then, either as slaked lime or carbonate of lime (chalk), finely pulverised, and added just before the rainy season sets in. An excess of lime is dangerous, as it destroys the organic matter of the soil, and causes it to lose its nitrogen. Moreover, the use of lime must not interfere with the ordinary manuring.

I have also a certain number of analyses of the Urban sugar cane manure, manufactured at Bloxwich, in Staffordshire, especially for the cane, and shall be able to show its composition as compared with stable manure and other artificial fertilisers, before this series of papers is concluded. The principal object worthy of note in this valuable product is the state in which the various elements of fertility exist in it. As the basis of it consists of the dried excreta of large towns, its phosphoric acid exists in several distinct states, which are assimilable by plants—first, as phosphate of ammonia and magnesia; next, as finely-divided phosphate of lime and as phosphate of soda. As a certain amount of bone meal is added to it for soils which have been long cultivated, and are deficient in lime and in phosphorus, this forms a fourth state in which the phosphoric acid exists in this manure. The nitrogen is also present as various single and double ammoniacal salts, as nitrogenous organic matter in bone, and as nitrogenous organic matter in the excreta. So also with regard to its potash and other ingredients, all of which are present in various states, and also in intimate combination with the organic matter. This I consider to be a most valuable condition in manures, and no artificial mixture possesses it. In fact, the Urban sugar cane manure is a natural product, rendered portable by the evaporation of its moisture, and when the chemical compositions of the soils for which it is destined are known, it is rendered more suitable to them by the addition of a little extra lime, potash, phosphorus, nitrogen, &c., as the case may be. It is a neutral manure, and therefore it will not increase the acidity of acid soils, but will rather neutralize it.

The odour of this manure being strong and pungent, like that of guano, it was feared that some difficulty would arise in shipping it to our colonies; but, packed in moderate-sized barrels, hundreds of tons, I hear, have been shipped since my last article, and not a word of complaint has arisen.

I have called special attention to this product because, as I stated in the June number of this journal, I anticipate great results from it; and, as regards the sugar cane, I believe it to be the finest acquisition that agriculture has made since the introduc-

tion of Peruvian guano. With regard to this portion of our subject, experiments are now being carried on in Demerara, Jamaica, Barbadoes, and Trinidad, and results will be soon forthcoming. The only reply I have yet received to my inquiries is contained in few words: "It is cheap, so we could use it liberally, and the crops are looking very well."

I learn that considerable sums of money have been recently expended upon a mixture of sulphate of ammonia, chloride of potassium, and superphosphate. Mixed with three-fourths of its weight of pen manure, cane ash, and any other refuse which is not acid, this expensive mixture would tell its tale, and produce good effects. But used by itself, it is too soluble and too acid. The first heavy shower washes the fertilizing ingredients of such a mixture out of the reach of the cane roots, which rarely extend to more than a foot in depth; whilst in thoroughly dry weather it would scarcely act at all. A better mixture, suitable to most soils, would consist of Peruvian guano, cane ash (or burnt trash), and stable manure; to which, for most Demerara soils, about one-fourth of its weight of gypsum may be added.

The refuse of distilleries, and all other refuse collected during the concentration and clarifying of the juice, should be put together into a large manure heap, mixed with megass ash, leaves, straw, stable manure, &c., and a heap of this kind should be attached to every plantation. It should be piled high, so that its ingredients may be well pressed together; it should also be protected from the rain, and any liquid which drains from it should not be wasted, but carried on to the ground with the manure itself, or soaked up by dry leaves or cane ash. The best method of using the acid superphosphate manures would be to mix them intimately with one-fourth their weight of good guano, and one-fourth their weight of cane ash, and apply the mixture at the rate of 5 to 8 cwts. to the acre, according to the mechanical condition of the soil, and its more or less effective drainage.

Analytical Laboratory, Putney, London, S.W.,
October 1, 1870.

CANE CULTURE IN AUSTRALIA.

(From "The Sugar Cane in Australia.")

[Continued from page 571].

To Determine the Exact Amount of Lime Required by a Given Quantity of Cane Juice.—This is not a difficult operation. The quantity of temper-lime is judged of by a proof or preliminary trial on a small scale, from which, when carefully done, data are obtained for calculating the exact weight required by a clarifier of known capacity.

This process of testing should be gone through whenever any difference takes place, or is suspected to have taken place, in the quality of the juice. Thus, for instance, when the canes come from another field, or when cut canes have lain from Saturday till Monday or Tuesday. The process is as follows:—Take half a pint of cane juice from a full clarifier that has been well stirred. By means of a funnel and piece of fine muslin, filter it to get rid of any mechanical impurities, and fill the measure bottle, which is made to contain, when full, and its stopper in its place, 250 septems, or the fortieth part of an imperial gallon; transfer this without loss to a beaker-glass, and heat it over a spirit-lamp, stirring occasionally with a glass rod till the juice boils. Apply a drop of the juice to a slip of the neutral test paper; it will be found to give an acid reaction more or less strong. Having filled the graduated test-measure up to zero with saturated lime water, pour a few drops into the boiling juice, stir it, and try another drop on the test paper. It will be found less acid than at first, and thus lime water is added in successive small quantities till a drop of the juice neither reddens nor blues the paper, but simply wets it without changing its colour, behaving just as distilled water would do. The indications of the test paper are extremely delicate, and it takes some practice to accustom the eye to judge of very slight changes of colour, but by a little practice with weak acid and alkaline solutions, even a tyro will soon acquire it. This point we may

call the point of exact neutrality, and when it is attained, the beaker should be taken off the stand, and its contents allowed to settle for a minute or two. If a precipitate consisting of pretty large floccules is seen floating about in, and readily separable from, and subsiding to the bottom of a perfectly transparent, although slightly coloured liquid, the point of proper clarification has been attained. That is to say, the point of neutrality and the point of proper clarification coincide. The exact number of septems of lime water that has been used is then carefully read off and noted.

If, however, the floccules are small, and do not readily separate from the juice, and the juice is not perfectly transparent, then it is not in a condition to filter readily, and on boiling it would still throw up scum, and thus lead to loss of juice, and produce a muscovado, the solution of which would contain floating solid matters. In a word, it is not properly clarified, and the beaker must be replaced over the lamp and its contents again brought to boil, and more lime water added in small portions at a time, till the indications of proper clarification, above described, are attained. The juice will now be capable of ready, and a very rapid filtration; but, although transparent, will have a deeper tint than if excess of lime water had not been required.

The total number of septems of lime water being noted, the calculation for finding the exact weight of quick lime for a clarifier of known capacity is very easy. Thus, supposing 250 septems (one fortieth of a gallon) to have required 20 septems of lime water to bring it to the point of exact neutrality, and 10 more to the point of proper clarification, then $30 \times 40 = 1200$, the number of septems that one gallon of the same juice would have taken. But every septem of saturated lime water at 86 deg. Fahrenheit—a very common temperature in this colony,—contains ·00862618 of a grain of quick lime, therefore, $1200 \times 00862618 = 10{\cdot}351416$, the grains of quick lime required by a gallon, and we have merely to multiply this amount by the number of gallons contained by the clarifier to know the weight in grains required by every charge of the clarifier. Thus, were the clarifier one containing room to boil 500 gallons, it would require 5175·7 grains, or, in round

numbers, eleven ounces and three-quarters avoirdupois of pure quick lime.

In the operation just described, saturated lime water is used because it is easy to have it of uniform strength; but on the large scale, to use lime water in place of milk of lime, would be to dilute the juice enormously, and waste fuel in the process of evaporation.

In preparing milk or cream of lime for clarification, it is of great importance to use pure, well burnt lime. Much of the temper-lime offered for sale in this colony [British Guiana] is of very inferior quality. The Bristol temper-lime, imported in jars, is generally, though by no means uniformly, good. That bought in puncheons is sometimes tolerable, but generally bad. Quick lime can only be kept unimpaired in close vessels. When the air is admitted, moisture and carbonic acid are both absorbed. Again, unless the limestone was carefully and thoroughly burnt, pieces of unburnt stone occur in it that do not slake, and whose weight has, of course, to be made up with good lime.

It would be easy on every estate to erect a small lime-kiln, in which the temper-lime required for any specified time could be thoroughly burnt, and the quick lime preserved in jars of moderate size, so that no unnecessary exposure to the air should occur. This lime would be far superior to what is in common use, and would cost less; for excellent limestone can be shipped in the Clyde, and probably also at Dublin or Bristol.* The construction of a kiln is simple, and it requires but little skill to arrange properly the layers of coal and limestone, and to regulate the draught. A very common plan in former days in the West Indies, was to burn the limestone in the flue of the coppers. The objection to this method is, that the lime and megass ash are liable to slagg together.

The proper quantity of quick lime having been weighed out, it is put into a pail or other convenient vessel, and there is poured on

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* While generally giving a preference to imported Bristol lime, many of our sugar boilers find that Rockhampton lime answers all purposes. There is no difficulty in Australia in getting good lime.—Ed.

it such a quantity of *boiling water* as shall slake the lime and form with it a uniform smooth cream or paste. Cold water ought not to be used, much less cane juice, in place of the boiling water.

It is not difficult so to proportion the lime and boiling water, that as much lime as will be required for the day can be slaked in an iron vessel, with a closely fitting top, at once admitting of the quantity of the cream used for each clarifier being measured.

Preparation and Use of Clay Batter.—In the previous directions, the cream of lime is recommended to be used along with clay batter, or gypsum, or whiting batter. The clay batter is best prepared by digging any of the stiff adhesive clays of the colony, containing little sand, from such a depth as to be free from roots, and as free from organic matter as possible. This clay should be well dried in the sun, the dry masses crushed by an edgestone or otherwise, and screened through a wire-gauze sieve of from ten to fourteen threads to the inch. Clean water is put into any appropriate vessel, and the sifted clay poured into it gradually, mixing it well up, till the whole is of the consistency of cream or batter. From four to eight gallons of this batter, mixed with the ascertained quantity of cream of lime, would go to a clarifier of 500 gallons of cane juice. When gypsum or whiting is used in place of the clay, it must be in very fine powder.

The use of the clay batter is to give density to the precipitate produced when the lime is added to the cane juice, and to cause it to subside quickly into a dense layer at the bottom of the subsiding vessels. When lime alone is used, the precipitate frequently takes long to subside, and often forms a large irregular mass in the middle, which is liable to break up during the time the clear juice is running off, and to get mixed with it, giving rise to the necessity of skimming if no filtration is used, or obstructing the filter unnecessarily when it is used. In a word, the clay batter renders the subsidence more quick and certain, and diminishes the amount of juice that is lost with the precipitate. By using clay batter one can often deal with cane juice of so inferior a quality as to be quite intractable by the ordinary process. On some estates where the clay batter is in use, the clay is simply dug, and, while moist,

mixed up with a sufficiency of water. This plan, although apparently simpler, is not really so, for it is much easier to form a batter of fine uniform quality with the dried and sifted clay and water, than with the moist tough clay and water.

After the addition of the temper-lime and clay batter, stirring, and boiling, the point of proper clarification is to be looked for and judged of by the means just given, but the use of the test paper is never to be omitted, for we might thus overlook a deficiency of lime. In fact, the test paper must give on the large scale the same indication it was found to do in the case of the preliminary trial.

Subsidence and Subsiding Vessels.—It has before been stated that, by getting rid of the feculencies of cane juice by subsidence and filtration rather than by skimming, or partly by skimming and partly by subsidence, the waste of juice is diminished from twenty or twenty-five per cent. to seven and a half per cent., or with good arrangements to less. If it be asked, Why not allow the juice to subside in the clarifier? it is replied that by having a subsiding vessel for every clarifier, half the number of clarifiers suffice, and that the best subsiding vessels cost but a mere trifle compared to the expense of clarifiers, and that subsidence is much more advantageously conducted in a proper subsiding vessel than in a clarifier.

That which interferes most with rapid and complete subsidence of the precipitate produced in clarification, is change of temperature, caused by air currents on the exterior of the subsiding vessel and on the surface of the juice. To enable subsidence to take place in the shortest time, it is not necessary that the juice should cool, but that it be kept perfectly still; and the less it cools the less is subsidence prevented by currents established in the mass of the juice. Hence subsiding vessels of wood are better than of metal; the base should be of somewhat greater diameter than the top or sides. They should not be too deep, should be fitted with close covers, and protected as carefully as possible from currents of air.

Experience will no doubt indicate better forms of subsiding vessels than any now in use, but one of the cheapest and best forms

hitherto employed is a circular vat of a cylindrical or slightly conical form, like Phillip's chemical precipitating jar, only wider and shallower in proportion, and each of the same capacity as the clarifier which supplies it. The use of subsiding vessels and filters necessarily infers that the clarifiers should be set at a greater height above the battery than usual, that the juice may be delivered from one vessel to another by gravity; for the want of height in boiling houses has operated more than any other cause to prevent the introduction of subsidence as one of the greatest improvements in clarification.

With regard to the drawing off of the clear juice from the subsiding vessel, various plans have been suggested, but hitherto Dr. Shier has found none so good as the following:—At about an inch or two from the bottom of the vat is fixed a stop-cock of sufficient capacity. The neck of this stop-cock is made longer than usual, so as to protrude inside the vessel several inches, and to this protruding tube is fixed a flexible tube of vulcanised indiarubber, as long as to reach, when straight, a foot or so above the top of the vat. The upper end of this tube is attached to a float, so adjusted resting on the surface of the juice, the mouth of the tube is maintained a short distance below the surface. During the subsidence, the tube is kept in a vertical position, with the float and open mouth above the surface of the juice. When the operation is finished, and the clear juice is to be run off, the stop-cock is opened a little and the float let gently down into the liquor, which is thus gradually drawn down to the filter or cistern below without disturbing the sediment, while the tube coils slowly and gently down on the bottom as the quantity of juice diminishes. It has, moreover, this advantage, that subsidence will be going on to some extent in the lower part of the vessel, while the upper and clearer part is running off. In cases where filtration is not thought necessary, the discharge of the last portions of clear juice requires attention, to guard against the passage of any portion of the sediment. When, however, the float is of the proper shape, and the mouth of the tube properly adjusted to it, the float rests on the bottom just in time to prevent the admission of any part of the

sediment. When the arrangements are good, the quantity of juice left along with the sediment is small, and on most estates it would be at once run, by the removal of a plug in the bottom of the vessel, to a gutter leading to the skimmings-cistern, to be used in making rum. When, however, it is desired to obtain all the juice, the thick part may be subjected to another subsidence in a subsiding vessel devoted to the purpose, or, what is better, run into a filter by itself.

Filtration and Neutralisation.—Although there are many cases, especially with fine juice, in which it may be absolutely unnecessary to filter, yet, from a variety of causes, such as peculiar kinds of juice, or when, from having an insufficient number of clarifiers, due time for subsidence cannot be spared, the juice, although well clarified, may yet have a small quantity of floccules floating in it which would give rise to a certain amount of scum; and since, in these cases, filtration is extremely desirable, Dr. Shier strongly recommends its being made the rule in all cases.

As regards the best fabric for filtration, that gentleman has tried a great many sorts, and found many of them too close, and liable to run too slow; while others run too fast, and do not remove the floccules. Most of the fabrics used to make bag-filters for refiners in England, he says, are not nearly so well fitted for filtering thin cane juice as for filtering thicker syrup, such, for instance, as is dense enough for being introduced into the vacuum pan. A very common fault is to run foul while running fast enough, and by the time the pores are sufficiently obstructed to run the juice quite bright, the quantity passed in a given time is much too small. But the Doctor has met with certain qualities of bag-filter stuff that, with proper precautions, answer well. Some of these precautions require special notice.

1. Cane juice that has been properly clarified, that is, when the point of proper clarification has been exactly hit, and provided the subsidence has been good, will filter readily quite bright, but it would be folly to try it without the subsidence, as the sediment would speedily choke the pores.

2. If the clarified juice is quite bright, and the floccules that

remain in it after subsidence are well defined, although light, it will not be difficult to filter, providing the floccules are not broken in introducing the juice into the filters. Hence the juice should glide into the upper cistern of the filter frame by the easiest descent, and the bags should be kept full. If let down from a considerable height with a gush, or if the stream impinge suddenly on the bottom of the cistern, the floccules will be broken, and the filtered juice will not be bright, till the delivery becomes too slow.

3. If the point of proper clarification has not been attained, the juice, even after it has had full time in the subsiding vessel, will not be bright, but hazy, and the particles that make it so are extremely small and ill-defined. Now to filter such juice always proves so tedious and difficult, and the juice is after all so liable to throw up scum when concentrating, that it is better to make sure of the attainment of the proper result before the juice is allowed to leave the clarifier.

Many boiling houses are so constructed, that it is impossible to find headway for steam clarifiers, subsiding vessels, filters, and supply cisterns, without pumping up the juice a second time—a thing to be avoided, if possible; hence Dr. Shier has been led to try other forms of filter than the ordinary filter-bags. He has succeeded best by using for each filter a bag of large dimensions laid almost horizontally on a wood or wicker frame placed over a receiving cistern. These filters answer well, and deliver a large quantity in a given time. It is needful, however, that the subsided liquor enter with little disturbance. Even when the under part of the bag has become clogged by sediment, the filtration goes on well and rapidly by the upper surface, and is promoted by laying several rods along it from end to end, forming gutters or channels by which the filtered juice passes to the end of the filter, and so to the cistern below. From the large quantity of juice these filters pass without requiring to be replaced, it is obvious that the floccules settle chiefly on the lower side, while the pores of the upper side remain comparatively free of obstruction. Although it takes much longer time, the thick sediment left in the

bottom of the subsiding vessel may, by a filter of this kind, be separated from almost all its adherent juice.

It may have occurred to some to ask, Whether the clay which forms a part of the sediment does not unfit it for constituting ferment in the liquor? To this Dr. Shier replies that he has made many trials, on the small scale, to ascertain the fact, and never found any disadvantage resulting; and he has never heard any complaint on the subject from estates where clay batter is in use.

Cleanliness in every vessel or piece of apparatus used in the boiling house being of so vital importance, he does not let the subject of filters pass without mentioning that unless they are washed thoroughly and made scrupulously clean, every time they are used, they very soon wear out, rot, are attacked by insects, and contaminate in place of purifying juice. As soon as they are to be changed, the filters are removed to the skimmings-cistern, turned inside out, and the thick sediment scraped off; they are then washed in successive waters till quite clean, when they are hung on lines to dry. He has found steeps of weak acid and alkaline solutions very useful in cleansing filters that had been badly washed. After steeping, the bags require to be washed free from all traces of the steep liquor. On no account ought filter-bags to remain any time unwashed or half washed in a heap, for fermentation speedily sets in and the bags are much weakened or destroyed.

NEUTRALISATION.—When the point of proper clarification can be attained with no excess, or a very trifling excess, of lime, nothing farther is necessary in the way of clarification, and the filtered juice is run into the evaporating vessels; for if animal charcoal is to be employed, this is not the proper stage for it, but when the juice has undergone considerable concentration. If, however, any considerable excess of lime has been requisite in effecting clarification, the excess is to be removed by neutralising it with dilute sulphuric acid. This is a simple process, and may be performed thus:—A stock of dilute sulphuric acid being always kept, a quantity of it is taken in a leaden or salt-glazed stoneware vessel, and added in moderate quantities at a time to the filtered juice, stirring and mixing the whole thoroughly till it ceases to give but

a barely perceptible alkaline reaction, as indicated by carefully prepared neutral litmus paper. It must on no account give an acid reaction; it is best to be exactly neutral, but the safest course is to cease adding acid when the alkaline reaction becomes extremely feeble. Were the lime left in considerable excess, the sugar would be dark in colour, and were the acid in excess the grain would be fine and soft, although the colour would be good.

When the juice is of uniform quality, and each clarifier is taking the same quantity of lime, it saves time to determine the amount of acid required for a given quantity of clarified juice, by making a proof or preliminary trial on the small scale, in a manner similar to that described as used to determine the quantity of lime to be used, only that a diluted test-acid would be used in place of the lime water, and the point of neutrality would be determined solely by the test-paper.

It is proper here to mention that this process of neutralization is applicable only after the filter, or to clarified juice, in which there is not found floating a vestige of flocculent matter, because this matter would be dissolved by the acid.

By following this method, Dr. Shier has prepared many specimens of sugar from canes of various sorts, and from many different localities in British Guiana. These samples have been transmitted to London, Glasgow, and other markets, to be valued, and have ranged from 3s. to 8s. per cwt. above the average price of Demerara muscovado in the market at the time. But this is not all: in consequence of the saving of juice effected by the mode of clarification being such as admitted of substituting subsidence and filtration for skimming, he obtained nearly 20 per cent. more of the juice than would have been got by the process as usually conducted, and the juice yielded from 1 lb. 4 oz. to 1 lb. 10 ozs. of muscovado per gallon.

Advantages.—The advantages attendant on a systematic arrangement of the process of clarification may be briefly recapitulated thus:

1. A rule is laid down for determining the exact amount of temper-lime to be employed. It ceases to be a matter of either taste or chance.

2. Means are taken which enable us to substitute subsidence and filtration for imperfect subsidence and skimming, whereby about 20 per cent more of the juice is available for being made into sugar.

3. The yield of sugar from a given quantity of juice is greater.

4. The sugar and molasses is materially improved in quality.

5. In thus improving the process in the early stage, the syrup is rendered fitter for being finished by improved processes, such as filtration through animal charcoal prior to having the evaporation concluded in the vacuum pan. The duty required of the animal charcoal is thus lessened, and, consequently, it will go further in decolorizing a well clarified syrup than when, as in the case of a badly clarified one, it has more colour to remove, and the duties of a mechanical filter also to perform.

In the processes of clarification already noticed, lime is the sole or principal substance employed. Numerous other substances have from time to time been suggested, and Dr. Shier has tried all that have been successful, and such others as appeared likely to be attended with good results. Many have been tried and abandoned; some are dangerous; some too complicated and troublesome; and some too expensive to justify their being recommended. It is proper, however, that an exception should be made in the case of bi-sulphite of lime, the clarifying agent recommended by M. Melsens.

Dr. Shier has tried this substance in a great variety of ways, but has been most successful with the following modification:—One per cent., or with some sorts of juice less than this quantity, of solution of bi-sulphite of lime is added to the juice as soon as possible after it is expressed, or better even during the expression. Heat is then applied, and the juice, after being boiled and stirred for a few minutes, has a mixture of cream of lime and clay batter added. The exact quantity of cream of lime is determined by a previous proof on the small scale, as described under the third method of clarification, only that no more lime is taken than is indicated at the point of exact neutrality. After boiling for five or ten minutes, beating down the scum, the contents of the clarifier are run down into the subsiding vessel, subsided and filtered as above described, and the juice is then fit for concentration.

The subsidence is generally not so good as by the former method, and the juice continues to cast up a small quantity of scum until the syrup becomes of considerable density. It is, however, of a very fine colour, and gives a better coloured muscovada than the former method.

Of the use of bi-sulphite of lime, Dr. Shier remarks :—

1. That without neutralizing the acidity of the cane juice, the sugar will, with some sorts of cane juice, be soft.

2. Without the clay-batter the subsidence is difficult, and the filtration proportionally so.

3. That it is an objection that skimming should, after all, be necessary; and particularly so when the process is intended to be finished in the vacuum pan, as, unless the liquor is thoroughly cleaned before entering that apparatus, there is no opportunity of doing it subsequently.

The bi-sulphite of lime is, however, an excellent clarifying agent, and gives so fine a sugar that, when this salt is manufactured at a cheap rate, there can be little doubt that in large boiling houses, presided over by skilful and observant superintendents, it will come into use. To the value of this article for checking fermentation we will refer amongst the other materials used for that purpose.

The quantity of lime required to temper cane juice properly varies very much. The chief causes of variation are the following, namely :—The variety or sort of cane cultivated, the nature of the cultivation, the degree of ripeness, the nature of the soil, whether manure has or has not been employed, the sort of manure, the state of the weather prior to, and at the time of cutting the canes, the length of time that has elapsed between the cutting and crushing of the cane, the amount of juice that has been expressed, the presence or absence of bored, rat-eaten, lodged, or rotten canes, and many other circumstances well known to practical men.

All cane juice is more or less acid to test-paper. The lime used acts partly in neutralizing the acid, but chiefly in combining with and precipitating various organic compounds that occur in variable quantities in the juice.

THE UTILISATION OF SEWAGE.

On the afternoon of the 15th Oct. a deputation from the Metropolitan Board of Works paid a visit of inspection to the sewage farm of Mr. W. Hope, called "Breton's Farm," at Hornchurch, near Romford, in Essex. A party, including several men of eminence in the world of science, such as Mr. Rawlinson, C.E.; Dr. Voelcker, the chemist of the Royal Agricultural Society; and Mr. E. Chadwick, as well as several members of the Romford Local Board, and a round dozen of the neighbouring farmers had been invited to meet them, and had the advantage of inspecting all the arrangements of the farm, under the guidance of Mr. Hope and his principal assistants, who afforded to the visitors every information as to the methods and, so far as they have at present been ascertained, the results of the cultivation adopted. Breton's Farm consists of 121 acres of light and poor gravelly soil, and it now receives the whole available sewage of the town of Romford—that is, of about 7,000 persons. This is conveyed to the land by an iron pipe of 18 inches in diameter, which is laid under ground, and discharges its contents into an open tank. From this tank the sewage is pumped to a height of 20 feet, and is then distributed over the land by iron or concrete troughs or "carriers," fitted with sluices and taps, so that the amount of sewage applied to any given portion of the field can be regulated with the greatest facility and nicety. To ensure the regular and even flow of the sewage when discharged from the carriers it was necessary to lay out the land with mathematical accuracy, and it has been levelled and formed by the theodolite into rectilinear beds of an uniform width of 30 feet, slightly inclining from the centre along which the sewage is applied. The carriers or open troughs by which the sewage is conveyed run along the top of each series of these beds or strikes; and at the bottom there is in every case a good road by means of which free access is provided for a horse and cart, or for the steam plough—the use of which is in contemplation—to every bed and crop. These arrangements, the carrying out of which involved the removal of 600 trees and a great

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length of heavy fences, the filling up of a number of ditches, and no less than nine ponds, as well as the complete under-draining of the whole farm were mainly carried out last year; but it was not until the middle of April, 1870, that Mr. Hope received any of the sewage from the town of Romford, and not until the following month that he obtained both the day and night supply.

Satisfactory, therefore, as have been the results of the present season's operations, they have been obtained under disadvantageous circumstances, and cannot be regarded as affording complete evidence of the benefits which may be derived from the application of sewage to even a poor and thin soil, which had already ruined more than one of those who had attempted to cultivate it. To mention only one drawback which arose from the lateness of the period at which the sewage was first received, Mr. Hope had not the advantage of being able to apply it to his seed beds; and thus many, if not all his plants, were not ready for setting out as early as they will be in a future year, and some of the crops have suffered in consequence—that is to say, have suffered in a comparative sense. Speaking positively, they have in all instances been much larger, not only than any that could have been grown upon the same land without the use of sewage, but than any which have been raised from much superior land in the immediate neighbourhood. The crops which have been, or are being raised on different parts of the farm, are of diverse character, but with all, the method of cultivation adopted has been attended with almost equal success. Italian rye grass, beans, peas, mangolds, carrots, broccoli, cabbages, savoys, beetroot, Batavia yams, Jersey cabbages, and Indian corn, have all grown with wonderful rapidity, and yielded abundant harvests under the stimulating and nourishing influence of the Romford sewage. The visitors of Saturday last, as they tramped over the farm under the guidance of its energetic proprietor, had an opportunity of witnessing the abundance and excellence of many of these crops. Even where the mangolds, from being planted late, had not attained any extraordinary size, it was noticeable that the plants were especially vigorous, and that there was not a vacant space in any of the rows.

All the plants which had been placed in the ground had thriven, and would give a good return. Where this crop had been specially treated with a view to forthcoming shows, the roots had attained an enormous size, and, like some of the cabbages, had assumed almost gigantic proportions. The carrots were very fine and well-grown, and the heads of the Walcheren broccoli were as white, and firm, and crisp as the finest cauliflowers; while the savoys, of unusual size and weight, were as round and hard as cannon balls, and some of the drumhead cabbages, although equally distinguished for closeness and firmness, were large enough in the heart to hold a good-sized child, and might, as was suggested upon the ground, very well be introduced into some pantomimic scene representing the kingdom of Brobdignag. The Indian corn had reached the respectable height of some eight feet, and with few exceptions each stalk carried a good-sized and well-filled cob or ear. These, unless we should have another spell of exceptionally hot weather, will not ripen; but in their green state they are readily eaten by horses and cattle, and prove excellent fodder. In the course of their peregrinations Mr. Hope's guests of course paid a visit to the tank in which the sewage is received before it is pumped on to the land. We need hardly say that the appearance of this miniature lake of nastiness was anything but agreeable; but its odour was by no means overpowering, or, indeed, very offensive. The rill of bright clear water which flowed in at one corner, and some of which was handed about in tumblers, looked as pure as the limpid stream which flows from the most effective filters that are to be seen in the windows of London dealers, had only a short time before flowed out of this hideous reservoir in a very different state. We had met it in the "carriers" flowing along in a dark inky stream, not smelling much, but covered with an ugly grey froth which reminded one of some of the most disagreeable details in the manufacture of sugar and rum, or suggested the idea that it had been used for a very foul wash indeed. With these reminiscences fresh in one's memory, it required some courage to comply with the pressing invitations to taste this "effluent water." There were, however, many of the party who

braved the attempt, and by all who tasted it the water was pronounced to be destitute of any except a slightly mineral flavour. In dry weather this effluent water, which has passed through the land and been collected by the drains, after mixing with the sewage, is again pumped over the fields; in wet weather it can be turned into the brook which is dignified by the name of the River Rom. We have omitted to mention that the rent paid by Mr. Hope is £3 per acre, and the cost of the sewage, at 2s. per head, £6 more.—*Daily News.*

CANE CULTURE IN THE ISLAND OF REUNION.

Report Presented to the Reunion Chamber of Agriculture.

(*Continued from page* 558.)

The deposits of guano we know are nearly exhausted, and for this resource we shall soon have to seek a substitute. In so doing, we must endeavour to estimate the artificial manures of commerce at their true value.

An important step has been made in our day towards the solution of the problem of vegetation—at least, as regards the conditions of agricultural production.

In the works of E. Boussingault and G. Ville it has been clearly shown that where nitrogenous matters, phosphate of lime, potash, and lime are present, plants will flourish even in a soil formed of calcined sand, but that they are in danger if one only of these substances be wanting. No one is ignorant of the extent of M. Ville's experiments, and of the importance with which the subject of chemical manures has been invested by his researches. It is then natural that we should look here for the supplemental manure that we require, and which, in the present state of our plantations, cattle breeding alone will not supply. The result of some experiments with this end in view we will now relate.

But it appears needful to say a few words respecting another source of manure—another very natural means of restitution which

may be derived from our towns and villages. Whilst all European nations have disdained to avail themselves of this inexhaustable source of fertilizing matter, the Chinese and Japanese have from time immemorial carefully collected it, and, indeed, scarcely know any other manure. Thus, whilst the soil of old Europe is menaced with sterility, which the introduction of the potato, of guano, and the supplies of fossil phosphates, have only retarded—whilst England spends her gold to gather from the whole world, and even from old battle-fields, the elements of fertility which she contemptuously sees lost in her great rivers, those two Oriental nations, on the contrary, have maintained the soil of their countries in a satisfactory state of fertility, and have no fears respecting the subsistence of their posterity. Thus foreseeing the exhaustion more or less evident of the known supplies of phosphates and potash, the civilized nations ought to turn their attention towards spreading on their fields the night soil and other refuse of their towns.

In Reunion, where a large proportion of the supplies of food comes from abroad, it is evident that it would be clear gain to spread on the soil the refuse which is so rich in nitrogen and mineral salts, and the best method of application is not to dessicate this refuse, but to adopt the Flemish plan—mix it with water, and, after some days allowed for fermentation, to irrigate the fields with it. But to return to our experiments. In accordance with a vote of the Chamber, the President procured from France a quantity of chemical manure, which he distributed to different planters. But prior to detailing results, we must observe that analyses of these chemical manures showed that their composition was irregular, and also that by accident some of the manures got mixed together, and thus some doubt is thrown on the value of some of the experiments. It will be understood that the results given as regards crops are estimates, the crops not having been yet gathered.

M. de Mazerieux reports on M. Ville's manure, placed at his disposal by the Chamber of Agriculture.

The manure was spread equally in the holes and on the surface of the soil. In a little while, after abundant rains, the appearance of the canes was perfectly satisfactory. The canes planted next

them, manured with guano, though well grown, were decidedly inferior. Unfortunately, from May, 1869, to March of this year, we were almost without rain; but I may state that the canes treated with Ville's manure throve better during the whole of the long drought than canes manured with guano. The former rapidly recovered after the coming of the rain, and are now fine and healthy. The latter continue sickly, their knots near together, and numerous shoots from the knots prevent the growth of the canes.

M. Alphonse Frappier writes from St. Pierre:—The manure sent me 14 months ago was applied, after some delay, on the worst part of my plantation. Notwithstanding the exceptional drought that has desolated us, the results appear promising; in fact, canes on the same soil, unmanured, are scarcely the height of the finger, whilst those treated with Ville's manure are two or three feet in length.

M. Laserne writes:—These are the comparative results noted in the beginning of March of four lots of 50 Ares [about an acre and a quarter] in a field of Guinham canes. The first, with about 10 cwt. of Ville's manure to the lot, spread half in the cane holes and half round about. The second with 10 kilos of farm manure in each hole. The third with the same quantity dug in between the holes. The fourth with 4oz. of guano and 5 kilos. of manure in each hole. The last presented the best appearance; and I think the first, treated with Ville's manure, looked no better than the second, treated with farm manure. The proof will be in the crop. Yet I am convinced that one experiment is not conclusive, and that many under variously modified circumstances are necessary. I must add that I omitted to mix the chemical manure with four or five times its weight of earth, as I should have done; and that it ought to be spread over the surface of the soil, not put into the cane holes.

The next writer states that his experiments were rendered useless by the severity of the drought.

M. Maurice de Tourris reports as follows:—It was towards the end of the year 1869 that I tried, for the first time, on a field of

canes three months grown, M. Ville's *complet* manure, No. 5, specially prepared for cane culture.*

As I shall not be able to report the actual results until next September, I will merely note a few remarks which I have made on the subject. In order that the results should be more striking, I made the experiments in comparison with farm manures, and I chose about five acres of land in the middle of a field, exhausted by successive crops, in which I operated according to M. Ville's directions.

FIRST DIVISION.—CHEMICAL MANURE, No. 5.

To secure a flat surface essential to the proper spreading of the manure, I levelled the ridges between the rows of canes, first stopping up the holes with straw, to prevent them being filled. I then removed the straw, and applied the manure thus—2½ kilos. lightly spread on the surface of each gaulette, and ½ kilo. equally divided between the holes (10), making 3 kilos. to each gaulette.

SECOND DIVISION.—FARM MANURE.

The holes and plants in the same conditions as in the first division, but treated with only 50 kilos. of farm manure per gaulette—*i.e.*, 5 to each hole.

It is now easy to see at the first glance that the canes treated with M. Ville's manure are much superior to those which have had farm manure. In the first the canes are thicker, longer, and better formed, though the leaves are not quite so green. At crop time we trust the figures will speak more plainly.

The next experiments are those made by M. LORY DES LANDES, at Ravine Glissante, Saint Rose.

FIRST EXPERIMENT, ANALYSED MANURES.

M. Lory took eleven portions of one Are each [about 120 square

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* It is probable that the manure referred to is composed as under:—

Rich superphosphate	400 kilos.
Fossil phosphate	200 ,,
Nitrate of potash	400 ,,
	1,000

yards], enumerated below, with his estimate of the value of the canes produced.

	Valuation of Canes.
No. 1.—Manure without mineral	4th Class.
2.— ,, ,, phosphate	4th ,,
3.— ,, ,, potash	4th ,,
5.—Manured with pure guano	1st ,,
6.—Manure *complet* G. Ville	1st ,,
7.— ,, ,, *intensif*	2nd ,,
8.—Farm manure and guano..........	5th ,,
9.—Sheep and goat manure	5th ,,
10.—Farm manure alone	5th ,,
11.—Without manure	3rd ,,

The second experiment was a comparison between half a hectare treated with Ville's *complet* manure, half in the holes and half round about, and half a hectare with 4 oz. guano in each cane hole. Both these lots of canes, between which there was nothing to choose, were long, vigorous, very green, and well formed, though the knots of each were not all that could be wished.

We conclude with an account of some observations which we made ourselves on the estate of Hubert-Delisle Brothers, at St. Benoit. The estimates are always merely approximative, but made by competent persons to whom the estate is well known, they have an incontestable value.

Experiment I.

Free soil, exhausted, in divisions of one Are each :—

Manure.	[Estimated] Yield of Sugar per gaulette.* (28·4 square yards.)
No. 1.—*Complet intensif*	15 lbs.
2.—*Complet*.........................	10 ,,
3.—Without mineral (nitrogenous only) ..	15 ,,
4.— ,, nitrogen (mineral only) ..	17 to 18 lbs.
5.— ,, potash................	do.
6.— ,, phosphate	do.

* Twenty pounds of sugar per gaulette is about 30 cwts. per acre.

There was no division without manure. The yield of the rest of the field, treated with farm manure and guano 64 grammes, to each hole, is estimated at 25 lbs. per gaulette.

Experiment II.

Free soil, exhausted—limed—part of the trash remaining on the land having been dug in; ploughed too deeply for some years:—

	Manure.	Estimated yield of Sugar per gaulette.
No. 1.	—*Complet intensif*	20 lbs.
2.	—*Complet*	5 ,,
3.	—Without mineral	5 ,,
4.	— ,, nitrogen	8 ,,
5.	— ,, potash	20 ,,
6.	— ,, phosphate	20 ,,

There was no division without manure. The yield of the rest of the field treated with farm manure and guano, as above, is estimated at 20 lbs. of sugar per gaulette.

Experiment III.—Ville's Manure.

In a field of ten acres, two half hectares were taken at a distance of 60 metres from one another, and each treated with a quarter of a ton of Ville's *complet* manure. The free soil was very exhausted, had been recently limed, had been ploughed too deeply for some years past, and it had been customary to dig in the trash.

At the end of some months, the canes growing badly in those parts where Ville's manure had been spread, farm manure was applied, about 5 kilos. to each hole. Results:—On one of the divisions the crop is a little better than the neighbouring canes treated with farm manure and guano as above; the other division is in no way different. The yield of sugar from each is estimated at 30lbs. of sugar per gaulette. The Ville manure was spread half in the holes and half on the cross ridges.

Experiment IV.—Nitrate of Potash, Farm Manure, Guano.

Free soil, light, exhausted. One thousand gaulettes in a large field were treated, in addition to the ordinary manure (6 kilos, of

farm manure and 64 grammes guano to each hole), with 64 grammes nitrate of potash. On this piece of land the yield was estimated at 30 lbs. per gaulette, and on the rest of the field 20 lbs. per gaulette.

Experiment V.—Molasses, Farm Manure, Guano.

1.—In a field of 2,000 gaulettes, 100 were treated with a litre of molasses to each hole three months before planting the canes, and 46 grammes of guano four months after. The molasses was that produced after four boilings in the *triple effet* and the vacuum pan. The soil was poor. Result:—The canes were cut last year. Those grown on the soil treated with the molasses were very healthy and green, and the yield (in sugar) was 30lbs. per gaulette. On the rest of the field the canes were very sickly, and the yield was only 7½lbs.

2.—Two hundred gaulettes in another field had received equally a litre of molasses per hole three months before planting, and 64 grammes of guano. The rest of the field was treated with farm manure and guano in the ordinary manner. Soil light and exhausted. The result of the use of molasses was remarkable. The yield of that portion of the field is estimated at 40 lbs. per gaulette; in the rest of the field at 15 lbs.

Experiment VI.—Scum, Refuse, Lime.

A compost, prepared in the manner before indicated, was employed on a field of 3,000 gaulettes, of which the soil is poor and cold, and where for some years past the canes have mildewed and grown very badly. Besides this manure, 64 grammes of guano had been placed in each cane hole. Result remarkable. The canes were very strong and green, without a trace of mildew; and although they suffered from the *borer*, the yield last season was 30 lbs. of sugar per gaulette.

Experiment VII.—Powdered Bones, Ashes, and Lime.

The result was satisfactory, but we cannot give the exact figures

Such are the observations we have made. Ignorance of the real composition of the chemical manures will account for the contradictions and insignificance of the results obtained, yet some of the preceding facts will at least afford us important lessons.

Three of the proprietors only have borne witness to the value of chemical manures. Two of these spread the manure uniformly over the surface. The others had not used it in this way. So that we may conclude that to put it in the holes or on the ridges between is not sufficient, but that its being regularly spread is indispensable.

This is a point on which all agriculturists agree, and on which M. Ville strongly insists. We do not say that chemical manures are infallible; we guard ourselves from any such statement which the complexities of the phenomena of vegetation do not authorize. It is not even certain that the following proportions given by M. Ville are the best:—

Acid phosphate of lime	600 k.
Nitrate of potash	300
Sulphate of lime	300
	1200

M. Ville himself recognises the great influence of climate, of the composition and depth of the soil, of the presence of humus (vegetable mould), and the rotation of crops.

But it is not the less certain that we have in the use of phosphates, of a nitrogenous salt, of potash, and of lime, a means formerly unknown to us of fertilizing those fields hitherto unmanured. The chief point is to use these substances in the best possible conditions, and to procure them as cheaply as possible, without rendering ourselves dependent on the manure merchants. To sum up our long report, the following conclusions appear to be deducible:—

I.—We must endeavour to lose nothing which proceeds from the cane; to take care of our manure heaps; not to allow our [megass]

ashes to be washed by the rain; to keep our molasses, or only to sell them at good prices; to collect all the refuse, and restore faithfully to the soil all that is not sugar.

II.—To apply these residues to a *portion* of our estates, so as to obtain, by the addition of a proper quantity of guano, or other suitable commercial manures, the maximum of crop.

III.—For the rest of our plantations we must have recourse—(1) to the ploughing in of leguminous crops, which will give to the soil the nitrogen absorbed from the air, the mineral salts derived from the sub-soil, and the humus, of which the influence is favourable in many ways; (2) to the breeding of cattle; (3) to the import of animal and other manures from abroad; (4) to the use of chemical manures.

IV.—Regarding the last, we must reduce the price by obtaining them direct from France—either the acid phosphate of lime guaranteed, or the fossile phosphate, which costs much less, and which, on account of the slow growth of the cane, would probably give as good results. We must buy our nitrate of potash in India, and thus save one-third of the cost. As for sulphate of lime, there is no necessity to pay freight for it as the limestone of Reunion is plentiful and of excellent quality.

V.—We must struggle unceasingly against routine, and spread our manures equally over the soil under pain of their remaining useless.

VI.—To sum up—being penetrated with the truth of the inexorable laws of restitution and thoroughly conversant with the fundamental principles of agricultural science, we must base our practice thereon. Indeed, when once our ideas are brought into accord with right principles, a reform in our practice will surely follow. When we have thus renounced the barbarous customs which have led us to the brink of ruin, we may anticipate better days for our agriculture, and look forward with hope.

ON THE USE OF LIME.

By Alfred Fryer.

The quantity of lime needed in the process of clarification of cane juice necessarily varies with the quality of the juice. The injury produced by excess of lime is certainly serious, but the injury arising from a deficit of this alkaline earth is still more serious, especially when the juice, being concentrated in the battery, is subjected to great heat for a considerable time.

Lime is generally added without rule and according to "the taste and fancy" of the operator, and the operator is usually an ignorant man; it is therefore not surprising that in order to avoid the greater evils arising from the deficit he falls into the lesser ones occasioned by excess. In fact, the practical inconvenience arising from too little lime—sticky, small grained sugar, from which the molasses will not drain—is such as to ensure the avoidance of this error.

In order to compare the amount of lime recommended by different authorities, it will be necessary to reduce all to a uniform standard. This shall be the number of pounds and tenths of pounds of caustic lime required for each 500 imperial gallons of cane juice. In order to eliminate the decimal and make use of whole numbers alone, the amount of lime calculated for each 100,000 lbs. of concrete or 50,000 gallons of juice may also be stated. In the West Indies the wine gallon was formerly used, and as the capacity of this is to the capacity of the imperial gallon as 833 to 1000, a reduction in this proportion has been made when needful.

	Pounds of Lime required for 500 imp. gals. of juice.		100,000 lbs. of concrete, or 50,000 gals. of juice.
Leonard Wray (pp. 349 and 351), maximum	3	....	300
,, minimum	1	....	100
G. R. Porter (p. 81), amount used regularly by a planter, but found to be excessive................	6	....	600
,, reduced amount by which a great improvement was effected ..	1·77	....	177
A planter in St. Kitts, 1865, reports:			
Good juice to require..............	1·25	....	125
Average juice......................	2·5	....	250
Very bad ,, ...	3·75	....	375
A planter in Jamaica, 1869, reports:			
Very bad juice to require	5·8	....	580
Amount commonly used	2·9	....	290
to	3·3	....	330
French central factories in West Indies:—			
Usually	2·5 to 3·75	..	250 to 375
Occasionally	5·5	....	550

From the foregoing table it appears—

1.—That the amount of lime in use varies within very wide limits, viz., from 1 to 6.

2.—That the amounts of lime used for good juice, average juice, and poor juice, stand nearly in the relation of 1, 2 and 3.

3.—That it is possible to continue to use three times as much lime as is requisite.

The maker of sugar, by means of the battery, finding it needful to guard against a clammy small-grained sugar from which the molasses will not drain, and having also to guard as much as he can against the formation of glucose by the use of excessive and prolonged heat, is tempted to use too much lime. The planters who use the concretor are more apt to fall into the opposite error—noticing that excess of lime, giving rise to black glucose products,

darkens the concrete, they are tempted to use too little alkali, and this error they fall into the more readily, as from the short time during which the juice is under treatment they think that the mischief arising from heat and acid must be unimportant; and as concrete is subjected to no draining process, they overlook the clammy character of spoiled concrete. Thus the planter who employs the battery is tempted to use too much lime. He who uses the concretor is tempted to use too little.

All raw sugar and all concrete are found on analysis to contain lime. Part of this lime has been drawn from the soil by the plant, and part has been added by the sugar-boiler. The lime drawn from the soil varies somewhat in amount, being dependent on the nature of the soil and on other conditions. A portion of this lime is removed in the scum and the dregs separated in the clarifier, and when the juice is made into sugar a further portion is removed in the molasses. In like manner part of the lime added by the boiler is blended with the scum and dregs, and part is removed in the molasses. Thus, whilst the amount of lime found in a given weight of sugar affords no exact indication of the amount added by the boiler, it gives an approximate indication, and furnishes a valuable means of comparing the quantity of lime used in the manufacture of different sugars.

Samples of sugar of various qualities were submitted to analysis, and the quantity of lime found, was calculated as pure caustic lime in 100,000 parts of sugar. Twenty-nine samples of concrete were also analysed. These samples comprise all qualities, from some of the most sticky or scorched to others of the finest quality equal to clayed Havana. The column headed "stickiness" shows this quality arranged according to an arbitrary standard, and as the value of the samples varies somewhat in inverse proportion to stickiness, and as this quality bears a marked relation to the proportion of glucose, the figure representing stickiness will afford an indication of the value of the sugar or concrete.

All Muscovado sugar and concrete contain free acid when they reach England. The column headed "acidity" shows the number of pounds of pure caustic lime required to make neutral 100,000

lbs. of sugar or concrete. The "glucose" column indicates the percentage of glucose found in each of the samples by means of the copper test. The column headed "variation" shows the difference between the percentage of cane sugar found in each sample by means of the polariscope (such estimation having been obtained by a complete polariscope analysis, including the inverse notation), and the indication before the solution had been treated with an acid. The symbol — shows that the complete analysis gave a lower figure than the first notation. The object of this "variation" column will be explained subsequently.

ANALYSES OF SUGARS.

	Stickiness.	Acidity.	Lime.	Glucose.	Variation
Unclayed Manilla	16	57	291	15·0	1·8
Native Madras	14	114	70	16·0	3·3
Brown Paraiba	5	31	375	8·5	0·3
St. Vincent Muscovado	4	29	281	4·7	— 0·5
Clayed Havana	1·5	39	95		
Martinique, fine quality	1·5	12	111	1·6	— 1·5

The six samples included in the foregoing table comprise the extreme qualities of refining sugar. The native Madras presented every indication of too little lime. The colour fair, the grain small and soft, and the sugar sticky; this accounts for only 70 parts of lime being present. The unclayed Manilla, Paraiba, and St. Vincent evidently had suffered from excess of lime, its scent being perceptible in the last-named sample. These samples were dark in colour, and characterised by a bold hard grain. The Havana and Martinique sugars were of extra fine quality, and there was no reason to infer from their appearance either an absence or an excess of lime.

The table may be read thus—

Good sugar contains about 100 parts of lime.

A marked excess is represented by 300.

The concretes in the following table have been selected to comprize every variety, and especially such samples as have been improperly made :—

Analyses of Concretes.

No.	Description of Concrete.	Sticki-ness.	Acidity.	Lime.	Glucose.	Varia-tion.
1	Antigua Concrete made in 1865....	2·5	171	116	3·8	1·3
2	,, ,, 40 tons in 1868..	1·5	36	131	1·8	—0·3
3	,, ,,single csk.,goodquality	1·5	31	65	..	..
4	,, ,, (unidentified)....	7	68·5	47	9·7	..
5	,, ,, *ex*Napier,hhd.No.289	17	94	19	17·4	..
6	,, ,, ,, ,, 279	10	83	13	13·7	..
7	,, ,, ,, ,, 299	10	68	30	16·5	..
8	,, ,, ,, ,, 235	4	54	89	7·9	..
9	,, ,, ,, ,, 244	2	45	65	5·5	..
10	,, ,, ,, ,, 247	2	46	102	4·8	..
11	,, ,, ,, ,, 224	1	38	67	2·1	..
12	,, ,, ,, ,, 265	1	27	95	1·9	..
13	,, ,,*ex* JohnPeile,, 561	2·5	34	52	..	..
14	,, ,, ,, ,, 656	15	37	61	..	..
15	,, ,, ,, ,, 658	30	63	134	..	..
16	,, ,, ,, ,, 640	1·5	20	104	..	..
17	,, ,, ,, ,, 660	30	68	104	..	..
18	100 hhds. Antigua Concrete	..	61	121	..	..
19	Trinidad Concrete................	10	99	77	10·0	2·4
20	Brick of Concrete from Jamaica....	2 5	44	48	4·3	0·2
21	Jamaica Concrete, scorched........	5	96	148	7·2	3·3
22	100 tons Egyptian Concrete, 1870..	1 5	50	95	3·5	0·3
23	Demerara Concrete, scorched	7	95	65	10·7	2·2
24	Porto Rico Concrete, samples	4	92	150	5·9	1·0
25	St. Kitts Concrete................	1	14	175	..	..
26	65 hhds. 9 trs. Demerara Concrete..	25	49	95	..	..
27	Contiguous { Dark layer	14	99	75	..	..
28	layers. { Light layer	1·5	58	65	..	..
29	1 hhd. Antigua Concrete, *ex* Westwood	25	39	180	..	..

No. 1 was made by a small model apparatus. The large amount of acidity is probably accounted for by the sample being more than five years old.

Nos. 2 and 3 were of excellent quality.

Nos. 5 to 12 were samples from separate hogsheads in a lot from Antigua in 1870. They comprised some very sticky samples, 5, 6, and 7; medium quality, 8, 9, and 10; and good quality, 11 and 12.

Nos. 13 to 17 were taken from separate hogsheads of another lot of Antigua concrete, 1870. Nos. 13 and 16 were good; Nos. 14, 15, and 17 were poor.

Nos. 21, 23, and 26 had evidently been subjected to too great heat in process of manufacture.

No. 22. An excellent parcel of concrete made by the Viceroy of Egypt at Rhoda in 1870.

No. 25. Average of the greater part of the concrete made in St. Kitts in 1869; it was almost perfect in quality.

Nos. 27 and 28. Contiguous layers in the same cask; the former dark and sticky; the latter light coloured and dry.

No. 29. Very inferior sample, probably made from sprouting canes after rain.

On comparing the sugar table with the concrete table the difference in the amount of lime attracts immediate attention:—

	Sugar.	Concrete.
Average amount of Lime	204	88
Maximum	375	180
Minimum	70	13

The best samples of concrete (nine in number) contain on the average 101 parts of lime (in 100,000). The worst samples of concrete (eleven in number) contain on the average 77 parts of lime. No sample of good concrete contains less than 65 parts, whilst nearly half of the inferior samples contain less than this amount. Where the amount of lime is very small, the glucose is invariably very large, and the concrete is bad. Thus, Nos. 5, 6, and 7, with only 22 parts of lime on the average, contain no less than 16 per cent. of glucose. There are however, instances of good concrete containing a relatively large amount of lime such as Nos. 2 and 25; but this amount is not absolutely large, it being less than the average amount found in sugar. Excess produces little mischief upon good juice, for such juice contains little glucose, and this it is which is affected by lime.

Some of the bad concrete contains a comparatively large amount of lime, such as Nos. 15, 17 and 29, yet this amount is much less than that found in sugars on the average. These samples appear to have been made from acid juice, the amount of lime was probably not sufficient to neutralize it, and part of the glucose is therefore, due to the composition of the juice itself, and part to its having been manufactured in an acid state.

Careful examination of the analyses induces the belief that approximatively —

Concrete from good juice should contain	70 parts of lime calculated as pure caustic.		
Concrete from average juice,	140	do.	do.
Concrete from inferior juice,	210	do.	do.

It has been observed that all concrete and raw sugar arrives in England in an acid state. This acidity arises from one or more of the following causes :—

A.—Free acid left in the juice in consequence of an insufficient quantity of lime being added.

B.—Acid caused by the decomposition of sugar and formation of caramel by great heat.

C.—Acid formed by changes due to fermentation during the voyage home.

The first may be looked for in concrete where lime has been too sparingly used. It is not often found in sugar.

The second is frequently found in sugars, chiefly those of low quality, and rarely, though occasionally, found in concrete.

The third is found in either sugar or concrete when it is sent home in a damp state.

Referring to the sugar table, a striking instance of A is found in the Native Madras. The colour, grain, and small amount of lime, show that the juice has been left acid. It would be needful to add no less than 114 lbs. of pure caustic lime to a solution of 100,000 lbs. of this sugar to neutralize its acidity. A small portion of this acidity is doubtless due to fermentation.

The acidity of the unclayed Manilla, precisely one-half of that of the native Madras, cannot be traced to want of lime, but arises from burning and fermentation.

The pure dry sugar from Martinique having been almost free from all these conditions, contains acid equivalent to only 12 parts of lime.

In order to ascertain if acid were produced by subjecting sugar solutions to great heat, the following three experiments were made :—

1st. Heated a solution of brown sugar until a little caramel was formed, and then tested for acidity. The acidity was the same as a portion not heated—viz., 39 parts of lime per 100,000 of sugar.

2nd. Heated a solution of pure white sugar until it was like black treacle. The acidity found = 160 parts of lime per 100,000 of sugar.

3rd. Heated a solution of St. Vincent sugar containing acid = 26 of lime; when caramelised deep brown it contained acid = 66 of lime; and a portion heated for a longer time, and a very deep brown colour, contained acid = 259 parts of lime per 100,000 parts of sugar.

If the inferiority of the low concretes is correctly traceable to insufficiency of lime, these samples should be very acid, for they must contain unneutralized a part of the original acid, and a further amount of acid formed in consequence of the damp state of the material. On the other hand, the good samples of concrete should contain much less acid. And such is precisely what is found. The eleven samples before selected as the worst contain on the average as much acid as would require 72 parts of lime to neutralise them, whilst the best eight samples (excluding that five years old) contain less than half that quantity of acidity—viz., 34 parts.

Two samples of concrete are described as scorched; these may be expected to be acid. Accordingly, 95 and 96 represent their acidity, and this is the more to be remarked as one of the samples contained no less than 148 parts of lime. From No. 28 we infer that though the juice must have been good to produce a concrete with so little stickiness as 1·5, yet the amount of lime in use was insufficient as 58 parts of acid remain; and from No. 27 it would appear that the amount of lime was quite inadequate, probably not half enough, as the stickiness 14 and the acidity 99 show that very much free acid was suffered to remain in the juice.

A portion of the acid left in the juice would probably be driven off in the process of concentration, and that which remained could not afterwards be separated by boiling. It is not easy to ascertain what proportion of the acid present in concrete was left in it when it was made, and what proportion has been formed since; but what-

ever can be driven off by boiling a solution of it, is probably of recent origin. A portion of acid concrete was made into a solution about equal in density to cane juice. This was boiled back to grain in eighty minutes, portions being taken and examined at various intervals. Of 92 parts of acid 28 were driven off, so in this instance one-third at least of the acid was probably formed after the sample left the concretor. This experiment shows how in the last-named series of experiments brown sugar heated until a little caramel was found, shows no increase of acidity. Doubtless acid was formed by the decomposition due to heat, but an equal amount of volatile acid was driven out from the sugar. The following are the details of the experiment:—

PORTO RICO CONCRETE.

	Gauge Beaumé.	Temperature Fahrenheit.	Minutes under heat.	Acidity calculated as lime per 100,000 lbs. concrete.
Cold........	11°	63°		92
Boiling	9°	212°	14	91
	19°	212°	24	89
	28°	216°	12	69
	35°	220°	10	64

Brought the rest to grain in 20 minutes more. The acidity of the sugar obtained=67 parts of lime per 100,000 parts of sugar. Altogether the sugar was heated 80 minutes.

Consideration of all the foregoing will show the importance of keeping cane juice during the process of manufacture on the concretor in a neutral state. Each clarifier of juice should be carefully tested with litmus paper, not only on its surface, but also as it is running off. The juice as it flows upon the trays, and as it leaves them, should be frequently examined with litmus paper. Carelessness in this respect may lead to grievous disappointment, whilst care will be amply repaid.

The influence of acid upon cane juice will be further considered in a future article.

THE BEET-ROOT SUGAR INDUSTRY IN FRANCE.

In consequence of the close investiture of Paris, the *Journal des Fabricants de Sucre* is for the present discontinued, the last number being published on the 15th September. *La Sucrerie Indigene* has been recommenced, although, as the editor observes, he writes in a town at present occupied by the Prussians. For the facts of the following account of the present state and prospects of the Beet-root Sugar Industry in France we are indebted to the latter journal:—

The sugar manufacture for the present season has commenced energetically, after having taken some precautions, rendered needful by the state of actual warfare in which the country is placed. The manufacturers of Picardy have adopted regulations to the following effect:—

That the beetroots shall be received at the usines as usual, but without any guarantee on the part of the manufacturer against loss by actual warfare.

That in case where, on account of the war, the usine shall be forced to cease working, and be unable to resume in reasonable time, the cultivators shall be at liberty to take back the beets from the usine in proportion to the quantities furnished by each.

That the price agreed on for the beets shall be maintained, but payment shall only be made after the sale of the sugar in the market.

That when this realisation shall be impossible, either wholly or in part on account of any of the casualties referable to the war, the sellers of the beets shall only have right of payment in proportion to the quantity of sugar which the manufacturer shall have realised in the market.

Similar regulations have been adopted in Avesnes, Cambrai, Douai, and Valenciennes.

It must not be supposed that the cultivators are unanimous in agreeing to these regulations, but it is most probable that if they

are to dispose of their beets at all for sugar making, they will have to come to the terms of the manufacturers.

Another important measure which is under consideration, is the warehousing of French beet sugars in Belgium as soon as possible after manufacture. The chief difficulty appears to be that there are few depôts in Belgium where any large quantity can be warehoused in bond; that is, the bonding warehouses are only calculated for the requirements of a small country.

As regards the crop, the following is a translation from the above named journal:—

In Le Nord and part of the Pas de Calais the crop is splendid. It is fine in the rest of the Pas de Calais, in La Somme, and l'Aisne. In l'Oise it is good in certain districts; middling in others. We speak of quantity. As regards quality, it is very ordinary. The density is not on the average above 4·6 to 5·0 without water. The returns of sugar are far from being as good as those of last year. They vary from 60 to 65 kilos. par hect. of first crystals boiled in open pans, to 65 to 70 kilos. par hect. boiled in vacuum pans. The juice is concentrated with facility.

At this present time the greater part of the factories are at work in the above departments. Labour is plentiful; indeed some of the makers in Le Nord who usually employ Belgian workmen are this year employing their own countrymen.

We cannot tell the exact extent of the damage done by the war on the beet crop and on the usines in les Ardennes, l'Aube, La Haute-Marne, La Marne, La Meurthe, La Meuse, Seine-et-Marne, and Seine-et-Oise. These departments have been, and still are, very much harrassed, but the usines there are not numerous, whilst the whole amount of their sugar production only reaches to that of La Somme or l'Oise, and there is not room to think that up to the present time any great deficiency is to be looked for. In l'Oise and in l'Aisne very few of the [beet-root] fields have suffered damage. As to the usines, one, that of Villeneuve-Saint-Germain, has been partially destroyed by the cannon of Soissons in

the defence of the place, and another, that of Moyant-Aconin, not far off, has also suffered.

In fine, the damage done on the whole is not considerable; but with the tendency of the enemy to extend their ravages, and with their vandalism, which shows itself in sacking and burning all that resists them, or all which is near to the centres of resistance except the fortified places, we are unfortunately threatened with further calamities.

METHOD OF PURIFYING LOAF SUGAR BY MEANS OF HIGH PRESSURE.

In No. 6 of *The Sugar Cane* (p. 57) was an abstract of a patent for purifying loaf sugar in the moulds by means of forcing the clearing syrup through it by hydrostatic or atmospheric pressure.* The last number of *La Sucrerie Indigene* contains a report on the working of the process, presented to the Association of Sugar Manufacturers of Eastern Bohemia, whose delegate was officially present at the inauguration of a set of the new apparatus. The following is a *resumé* of a translation of this report.

The inventor, M. Jos. Kodl, manager of a sugar manufactory at Ronov, has taken out patents in Austria and France. His first experiments were made in the season of 1868-69, and, after many unsuccessful trials, he succeeded, in December, 1869, in establishing a perfect *clairçage* apparatus, which has worked since without interruption in the manufactory at Ronof.

The principle of the process is based on the pressure which is exercised by a column of liquid, or compressed air, contained in a

* Extract from abstract. The moulds for the loaves are placed as usual, but are provided with a ledge at the base of the cone. On this ledge is placed a covering which, by being screwed on a leathern washer, may be hermetically closed. There are two holes in this cover—one for the air tap, the other for an indian rubber tube, which conducts the clarifying syrup to the mould from a reservoir above, submitted to the pressure of one atmosphere.

closed reservoir—a column of water 32 feet high exercising, as is well known, a pressure of one atmosphere, or 14·71lbs. per square inch. The higher the column the greater the pressure, and if the body on which the liquid column acts is mobile, it moves in the direction of the pressure acting on it. Suppose, then, instead of a column of water, a column of clear liquor of a certain height, acting on a sugar-mould filled with sugar. Between the crystals of sugar in the mould there is syrup in a fluid state. The pressure of the column of clear liquor which rests on the bottom of the mould is distributed equally in all directions, but acts chiefly on the fluid syrup which drains off, pushing it continually towards the aperture at the point of the mould. The more powerful the pressure, the faster the syrup is driven off. The space left free between the crystals by the displaced syrup is filled by a portion of the clear liquor from the column; and when the pressure acts continuously, the syrup flows continuously from the mould, and the same action is continued by the clear liquor from the column which takes the place of the displaced syrup. On this principle the new method of *clairçage*, and the construction of the apparatus employed to realize it, depends. This last consists of—

1. The bed in which the moulds are fixed.
2. The cisterns for the clear liquor.
3. The cisterns for the syrups which drains away.
4. A *monte-jus*.

The beds are constructed to hold 303 moulds.

The *monte-jus* is, properly speaking, the motive power of the apparatus. Its use depends entirely on the judicious utilization of the pressure of the atmosphere.

The manipulation of the apparatus comprises the following operations:—

1. Putting the moulds in their places.
2. Screwing their covers on.
3. Proving the hermetical closing of the battery.
4. The *clairçage* proper.
5. The purge.

The loaves are then dried in the stove.

During the "*clairçage*," a continuous stream of green syrup flows from the points of the moulds, and is collected in the cistern above mentioned; after a certain time this syrup becomes more and more pure and clear, and in about an hour and a quarter is so much finer that it may be collected in a separate cistern, into which it continues to flow for another hour. It has then assumed a beautiful pure yellow colour, and is allowed to flow into the dripping cistern for twenty minutes, when it has the appearance of perfectly pure clearing liquor, and the *clairçage* proper is complete.

In a *clairçage* effected on the 16th of December, 1869, 239 loaves were operated on, each weighing $30\frac{2}{3}$ lbs. In this way $239 \times 30\frac{2}{3} = 7,329\frac{1}{3}$ lbs. of sugar were submitted to *clairçage* with 110 cubic feet of clear liquor (*clairce*) at $73\frac{1}{2}$ lbs. per foot, say 8,085 lbs. of *clairce*, marking $67\frac{1}{2}$ per cent on the saccharometer (36° B.), at a temperature of about 80° Fahrenheit. We must observe that the manufactory not having enough *couvert* and dripping syrup (for first passing through the loaves) the pure *clairce* was used instead. The quantity of green syrup collected was 39 cubic feet at $75\frac{1}{2}$ lbs. per foot, or $2,944\frac{1}{2}$ lbs.; of *couvert*, 42 cubic feet at 74 lbs., or 3,108 lbs., and of dripping syrup $34\frac{1}{2}$ cubic feet at $73\frac{1}{2}$ lbs. or $2,535\frac{3}{4}$ lbs. The time occupied in the whole operation was as under:—

	h.	min.
1.—Carrying the moulds from the filling chamber	0	30
2.—Placing the moulds	0	45
3.—Proving the battery	1	45
4.—Running off the green syrup	1	15
5.— ,, ,, *couvert* do.	1	0
6.— ,, ,, dripping do.	0	21
7.—Purge..	0	33
8.—Dismounting the battery	0	44
	6	53

Of this time the *clairçage* proper only occupied 2 h. 36 min. The loaves were purified quite up to their points; the clearing liquor

penetrating quite through them; they were not at all porous, and were impenetrable to the hand.

When we remember the total duration of the process, and reflect that when the workmen get a little more skilled, some of the operations will be effected in much less time, we may see that it will be possible to effect with this apparatus 3 *clairçages* in 24 hours.

The *procès verbal* of the operations contains the following passage:—

"The loaves were boiled the 16th December, in the afternoon; carried to the apparatus on the 17th in the afternoon, and taken away in the evening. Taken from their moulds on the morning of the 21st, and to the stove in the afternoon.

The loaves then were so far advanced in the 4½ days as to be able to be taken to the stove. On emptying the moulds only four loaves were found imperfectly cleared. This proceeded from some defect in the moulds; the rest were all that could be wished.

Amongst the advantages of the process are these:—The sugar is perfect. There is considerable economy of time and labour; the latter may be reckoned at the lowest computation at one-half the number of hands employed on the old system. The process is so simple that the necessary surveillance is very easily exercised. There is much greater rapidity possible in boiling the syrups, which thus run less danger of deterioration; the green syrup can be returned to the coppers within 24 hours. Economy of capital in plant, as well on account of the new arrangements as from the diminution in the number of moulds required.

ARRANGEMENT OF CLARIFIERS, &c., FOR A SUGAR HOUSE.

(From The Artizan.)

In giving a description of a sugar mill, we pointed out that, although many other processes had been invented for the purpose of expressing the juice from sugar canes, they were all practically useless from their inability to devour, in anything approaching to a

reasonable time, the enormous quantity of canes that are required for supplying sufficient juice to the boiling house. The process of forcibly expressing the juice from the canes by the aid of roller mills has, however, one serious drawback—viz., that besides obtaining what is wanted, a considerable quantity of what is not wanted comes with it.

The canes, as they issue from a good mill, have somewhat the appearance of a sheet of pasteboard, the quantity of which amounts to about 20 per cent. of the quantity that entered the mill. It is comparatively dry to the touch, but is found to consist of about one half juice, the remainder being woody fibre and a small proportion of silica. This cane trash, or megass, ought, we consider, to supply sufficient fuel for working the whole plant for the manufacture of sugar, and thus entirely supersede the employment of coal or wood; but we must leave this subject for future consideration.

The remaining 80 per cent. consists of what is commonly called cane juice, with a small amount of woody fibre held in suspension. The term cane juice can, however, scarcely be applied correctly to the liquid under consideration, as it contains, in addition to sugar and water, small quantities of various deleterious substances, forced out of the canes by the intense pressure to which they have been subjected. These impurities consist of green feculæ, green wax, gum, gluten, and various salts of lime, potash, soda, &c., and a peculiar substance, the composition of which is unknown. The respective amount of their impurities varies considerably in different species of canes, and also from various other causes, but impurities exist in greater or less proportion in all cane juice; besides this, there is usually a certain amount of acid, caused by the exposure of the ends of the canes from the time they were cut in the field. It will be readily perceived that a mixture of this description in a climate where the normal temperature may always be taken at somewhat above 80° is excessively liable to ferment, and it is therefore very important that it should be left in that state as short a time as possible. For this purpose it is advantageous to have the mill as near to the clarifiers as possible, so that time may not be lost by the juice having to travel long distances through gutters. It

was the practice in the West Indies, when steam mills were first adopted, to erect them at a considerable distance from the boiling houses, the planters being under the impression that such a precaution was necessary to save the shingles of which the roofs are composed from being ignited by the sparks from the chimneys. It is, consequently, not at all unusual to find that there is a distance of 150 to 200 feet between the mill and the clarifiers, the communication between them being effected by means of an open gutter, along which the cane juice leisurely travels. This system is much to be deprecated, as the juice must be treated with an extra quantity of lime to neutralize the acidity thus acquired, which is well known to darken the colour of the sugar. The danger of fire from the boiler chimney appears to be very small; at all events, a galvanised iron roof would insure the buildings much more efficiently.

THE PRESENT SEASON'S CROPS OF COLONIAL SUGAR.

(*Faom Licht's Monthly Circular.*)

The reports from the colonial sugar-producing countries bring in reality nothing new. The complaints from Reunion and Mauritius about the present crop have, where possible, increased; and for the latter island it is now estimated at scarcely 90,000 tons—that is to say, 40 to 48,000 tons less than that of last season. From Java the progress of the new crop is delayed; but there, as in Manilla, in Brazil, in Barbadoes, Jamaica, and Louisiana, as also in Cuba and Porto Rico,—good average crops are expected. From Martinique a negro rising is reported, in which some lives and much property have fallen a sacrifice. Shipments from Cuba to the end of the passing crop may yet reach the full amount of former years; the stocks at Havanna and Matanzas on 1st September were certainly 7,000 tons less than for twelve months past, and leave less for shipment in the last four months of this year; however, the exports from 1st January to 3rd September exceed those of the same period of last year by 34,000 tons.

The shipments in Pernambuco since the 1st October to the end of August reach 72,865 tons, against 70,395 tons in 1868-9, and 42,268 tons in 1867-8. The exports from Bahia were in the same time 29,128 tons, against 38,339 tons, and 43,262 tons in the two former years, whilst the stock is estimated at 4,890, against 3,100 tons and 2,400 at the end of August in 1869 and 1868 respectively. To the 1st date, 1870, were shipped from the East Indies to England and France 22,200 tons, against 20,900 and 24,800 tons in the two previous years; and from Java to Holland to the same time 8,892, against 3,941 tons and 16,374 tons in 1869 and 1868 respectively.

SUGAR FROM PALM TREES, &c.

Much of the sugar used by the working classes in Ceylon is manufactured from the common palms of that country; such as the cocoanut palm (*cocus nuncifera*); the Palmyra palm (*corypha umbracalifera*); and the date palm (*phœnix dactylifera*). The process is as follows:—The sweet juice, called by the Europeans "toddy," by the natives "suri," is gathered from the unexpanded flowers of the cocoanut and Palmyra palms in this manner. When it is intended to draw juice from a "tope" or cluster of trees, the native, called a "toddy-drawer," connects the heads of a large number of trees by means of the stems of creeping plants. To gain access to their tops, the toddy-drawer selects a tree near the centre of the tope, the trunk of which he surrounds with a number of bands made from creepers, each about a foot distant. He then ascends by means of these bands, and, connecting the tops, passes from tree to tree. As he goes he cuts off the point of the blossom or spathe, and ties it firmly with a ligature, beating it with a stick to draw the sap to the wounded part; while suspended from the spathe he hangs an earthen vessel called a "chatty." The juice soon begins to flow, a thin portion of the flower and spathe being cut off daily, and the end of the stump tied afresh.

The toddy-drawer ascends early each morning, and detaching

the chatties suspended overnight, conveys them to the earth by means of a thin line. The chatty is then emptied by a native on the ground, and again drawn up to be suspended and refilled. A good healthy blossom will yield from two to four pints of sweet juice daily for four or five weeks. Sometimes two spathes on one tree are tapped at one time. The juice is seldom drawn from a tope above six or seven months at a time, as the operation exhausts the trees, and in some degree interferes with their producing fruit. The fresh drawn juice is sweet, and in general operates as a mild laxative. When it is intended to distil arrack from the suri, the toddy-drawers do not change or clean the chatties into which the juice is received; hence it soon ferments and emits an acid smell, and becomes by fermentation highly intoxicating. The liquor is used by natives and sometimes European soldiers. Arrack can be distilled from suri the same day it is drawn, but it may be delayed for a few days without injuring the quality. Suri yields, by distillation, about one-eighth part of proof spirit, which fetches in the natives' hands about 1s. 6d. per gallon. Suri also makes an excellent yeast, and, by allowing it to pass into the acetous fermentation, it makes vinegar.

The preparation of jaggery, or native sugar, is as follows:—When it is intended to extract jaggery from suri, great care is taken to prevent it from fermenting. The chatties are emptied twice or thrice in the twenty-four hours, and each time the chatty is well cleaned, and a small quantity of *chunam* (lime) is thrown into it before being replaced. The suri (called meera when collected from the Palmyra Palm) is filtered through a portion of the reticulated substance found at the base of the leaf. The juice is then slowly boiled in an earthenware vessel until it becomes light-coloured, and acquires a degree of consistence like syrup from the cane. While still warm and semi-fluid, it is poured into sections of cocoanut shells, where it soon becomes solid. Twenty-four ounces of jaggery may be procured from a gallon of meera; three quarts of suri yield about one pound of sugar.

It appears then that meera is somewhat richer in saccharine than cane juice is. Jaggery contains both the crystallizable portion of

the juice and a quantity of molasses or liquid sugar, again showing a similarity to cane juice. The coarse sugar (jaggery) is generally sold in little hemispherical loaves, from the form of the vessel in which it cools. It has a deep chocolate colour, and, when broken, presents clear shining particles of sugar. The ordinary price of this raw sugar is about 2d. per pound, and it is the only article of the kind used by the natives—no other being prepared in Ceylon. They enjoy the juice of the sugar cane by masticating the green shoots, but in no other way, although they have a name for sugar manufactured in other countries from the sugar cane—they call it *chinnee*. The soldiers ordinarily use jaggery, and Europeans of nearly all ranks prefer it for sweetening coffee. Sugar-candy, imported mostly from China, is the saccharine substance commonly used by the better class of Europeans in India. In the interior of Ceylon, the natives extract a sweet juice from the Nepery tree (*Caryota urens*), and manufacture it into a jaggery. This tree grows spontaneously in the woods. Sugar, from the Date Palm, is extracted by cutting off the head or crown, and scooping the top of the trunk into the shape of a basin, where the sap, in ascending, lodges at the rate of three or four quarts a day for a fortnight; after this the quantity diminishes, and at the end of two months the tree becomes dry, and serves only for timber or firewood. The liquor, which is of a more luscious sweetness than honey, is of the consistence of a thin syrup, but quickly becomes tart and ropy, acquiring an intoxicating quality. It is usual for persons of rank amongst the natives to entertain their guests with this drink, as it is an agreeable spirit; but to render it stronger the natives sometimes add green chilies. When in a pure state it is called palm wine, when strong, arrack. The sugar is extracted from the boiled syrup in the same manner as the other processes. It is generally supposed that the sugar of the ancients, which was imported from India, was the produce of the palm family, and not of the sugar cane, as the extraction of sugar from the sugar cane is more difficult than from the juice of the palms: and this is the reason why palm sugar is better known than cane sugar even in countries where the cane is indigenous. The natives of India to this day

understand little of the art of extracting sugar from the cane; but the Chinese have understood this usefnl art from times long past.

Jaggery also answers another useful purpose in building. Lime *(chunam)* to which a small quantity of jaggery is added, takes a very fine polish like marble. Walls are prepared for receiving this covering by wetting them with a strong solution of the husk of unripe cocoanuts, and the same fluid is used for mixing and tempering the materials. In Madras and other parts of India, the flat tops of houses are covered with this cement. It is also much used to cover pillars and to form the floors of rooms. Floors of this kind are sometimes stained, and made to resemble the finest marble. It is said that this jaggery cement has succeeded well in Europe, and was discovered quite by accident. A native trying his syrup by the usual thumb and finger process was struck by its adhesiveness, and hence the happy thought of applying it to building purposes. Some curious specimens of sugar were exhibited at the Great Exhibition, London—such as sugar from the Gomuti palm (*Arenga saccharifera*) from Java; date palm sugar from the Deccan, India; Nipa sugar from the stems of *Nipa fruiticaus:* and sugar from the flowers of an Indian tree called *Bassia catifolia;* sugar from the butter tree (*Bassia butyracea*); sugar-candy from China; sugar and molasses from the grape; sugar from maize, carrots, and parsnips; sugar from the grasses, *Sorghum saccharatum, saccharatum sinense, Gyperium saccharoides*, and several of the millets.

The Crop in Mauritius (*From the Commercial Gazette*).—The reports of the yield of the canes are not favourable, and we shall have to reduce our former estimate of 100,000 tons. When plantations have suffered from drought their appearance is deceptive, and it will only be on a few estates in the interior that a fair crop will be made. On estates on the sea side the reduction will be very considerable.

PRICES OF SUGAR CANE IN NEW SOUTH WALES.

Mr. J. G. Ross, manager of the Colonial Sugar Refining Company, Sydney, has addressed the following letter to the *Macleay Herald:*

"The report of Mr. Melmoth Hall upon the sugar cane growing on the Macleay having been received, it has been found necessary in consequence of the large quantity blown down and otherwise injured by the late gale, as well as from the irregular shape of many of the cane fields, to abandon the original intention of purchasing the cane by the acre, and to buy it by the ton weight instead. The punts employed to convey the cane to the mill will be marked, to show the weight of cane put into them; and, to satisfy the farmers that they may rely on the accuracy of this mode of measurement, they will be invited to appoint three of their number to see that the markings are all correctly made. For sound ripe cane, from which all the side shoots and dead leaves have been removed, the company will pay 10s. per ton; for inferior lots something less.

"The company will provide cane cutters and punts; but the farmers will have to cart the bundles from the field to the bank, and to allow the gangs of cutters to encamp on their land. The company must of course reserve to itself the right of cutting at such time and in such manner as will best suit them; but, unless accidents prevent, they undertake to have all the cane they may purchase cut or broken out before the 1st of February. To encourage the farmers to pay attention to the improvements of their land, and to the cultivation of their cane, the company now offer two prizes of £50 each for the best ten or more acres, and two prizes of £25 each for the best five or ten acres of cane available for the Darkwater Mill in the 1871 season. Persons intending to compete for these prizes will please forward their names and addresses to this office prior to the 1st of August, so that their plantations may from time to time be inspected. Carts for conveying the cane from the field to their river bank will be provided by the company."

Correspondence.

SUGAR CULTIVATION IN EGYPT.

To the Editor of the Sugar Cane.

Sir,

I have just received a letter from a friend of mine in Alexandria giving me some information about the state of sugar cultivation in Egypt, which may be interesting to your readers.

His Highness the Viceroy of Egypt, it is well known, has been during the last three or four years the largest sugar manufacturer in the world, and Egypt, in comparison to its population, will soon produce the largest quantity of sugar made in *one* country.

His Highness the Viceroy has at present contracted for, or rather intends to have at work within two years, eighteen large sugar factories, at seven of which sugar has already been made, and at some of them for the last eight years. The greater part of the Viceroy's sugar factories are supplied with crushing mills, with 6 or 7 feet rollers of 30 and 34 inches diameter. One half of these factories will be eventually worked with two crushing mills, and the other half with four mills.

The firm of Cail & Co., of Paris, has for the last nine years supplied the Viceroy with very nearly all the sugar plant he has required; but he has lately given three large orders to English firms—viz., two to the firm of Eastons, Amos, and Anderson, London, and one to the firm of Preston, Fawcet, and Co., Liverpool, partly with the object of creating competition between English firms and the well-known firm of Cail. I must add that one of the oldest and largest sugar factories of the Viceroy was built by the firm of Forrester and Co., Liverpool, of which a description was given in No. 12 of *The Sugar Cane.*

It is not known yet how many feddans, or acres, of cane will be required to supply those eighteen factories; but it is probably a fair calculation to reckon 3,000 feddans on an average for each of them, which makes a total of about 50,000 feddans, or acres, of cane; and taking the produce per acre at 1 ton of sugar at the

very least, we are safe in saying that His Highness the Viceroy of Egypt will in two years time be able to manufacture 50,000 tons of sugar per annum. The greater part of this will be vacuum pan sugar, drained in centrifugals.

It is said that His Highness intends the greater portion of this sugar for consumption in the Levant, where he will obtain a better nett price than, on account of import duties, is paid in England and some other countries.

It appears that the Viceroy has decided to work during next grinding season the two concretors (mentioned in the article, page 377, of No. 12 of this Magazine), in connection with vacuum pans. That is to say, to evaporate the clarified cane juice to the density of 28° or 30° Baumé on the concretors, and to crystallize the sugar in the vacuum pans. By this means the damage done to the sugar by prolonged heat will be very materially lessened, inasmuch as the juice is reduced to the required density in as few minutes by this apparatus as it requires hours by the old process. The factory at Rhoda, like all the others, being supplied with charcoal filters, the syrup will most likely be sent through the charcoal before it goes to the vacuum pans.

I also learnt that the firm of Eastons, Amos, and Anderson are about to supply the Viceroy with a set of evaporators to be heated by steam, instead of a direct fire. These will also work in connection with the vacuum pans. The same firm is about to introduce a crushing mill on a new principle—namely, with rollers 5 feet long by 4 feet in diameter, and with gearing at both ends, in order to divide the strain as much as possible equally over the three rollers. I am not familiar enough with the details of this design to give an opinion about it, but I have little doubt that a mill of that description will do its work as well, and perhaps better, than a mill with longer rollers and of less diameter, for I don't believe that the reason the old system has been used for so many years is that it needs no improvement.

I remain, Sir,

Yours, &c.,

T.

TO THE EDITOR OF THE SUGAR CANE.

SIR,

I was in a train the other day with two or three farmers, whose conversation was chiefly about cattle, and one of them remarked that he had heard the *rinderpest* prevailed mostly in those parts of the continent where the beet was cultivated. It was not, he said, so solid and good a root as the turnip, even in its natural state; but after it had passed through the mill, and been reduced to slush, with all its saccharine and nutritious particles squeezed out, it was, though eagerly eaten, or rather swallowed, by the cattle, a windy and poor food, which swelled them out, without giving them firmness of flesh and fat, and possibly prepared them for disease. Atmospheric and infectious diseases fall principally upon men whose strength has been reduced by uninvigorating diet, and the same rule probably holds good in other animals. The subject is worth looking into, and if it shall be found that the farmer was right, the importers of cattle would do well not to procure them from the beet-growing districts.

E.

TO THE EDITOR OF THE SUGAR CANE.

SIR,

Your interesting periodical has only now been brought under my notice, by a friend. I am glad to see this ground fertilised by scientific cultivation, as I apprehend it is the only plan that can afford the prospect of success. Generation after generation of "practical planters" devoted their life-long experience to lead us up to the lamentable fact that, as a rule, we lose more sugar in its manufacture than is sold.

It must not be inferred that I am disposed to trifle with experience, nor treat it lightly; on the contrary, I prefer to accumulate experience for a best foundation, and approach it, at all times, with becoming gravity. We may not mistake flippant egotism for gravity. Your admission of the records of experience considerably increases the value of your pages. It is quite true that experience differs with different localities, and it remains for science to reconcile them. It would be desirable to know, also, something

about the nature and composition of the soil cultivated, and the duration and changes of the rainy season, &c., at each specified locality.

Who has not seen, as a planter, canes fifteen and sixteen feet long, and other canes four or five feet long, growing in the same field, the former in a hollow, and the latter—the shorter canes—on a higher and drier ground? We want these facts also. Again, as to manures, we have the rich land of Jamaica and the sandy soil of the island of Luzon. The former receives "the food of plants," in addition to its natural richness; whilst the arenaceous soil of Luzon gets no manure whatever, and the crops of sugar canes there are abundant. They do not grow "ratoons," but break up the ground as soon as practicable, well work it with their primitive plough, which can penetrate only light land, and plant afresh, without one atom of manure. They have four months of rain, two months of occasional showers, four months without rain, followed by two months of occasional showers, which are preludes to the rainy season.

I may state at once that one of the expressions adopted by Liebig —"the food of plants"—has always been a difficulty with me, and is not fully appreciated. I fear it has led many into error. Plants are well known to be abundantly supplied with carbon, wherewith to build their fabrics to any dimensions their nature may require; and time affords the opportunity, so long as they are healthy and vigorous. The atmosphere is their abundant storehouse, and they receive this necessary carbon by the stomata of their leaves, not from the soil, by the rootlets; these latter have another function. It may not be difficult hereafter to point at the true functions of soils and manures, as we go on accumulating experience.

I am aware that theory *alone* may lead a man into error, and so can experience *alone*. Take a well-known case:—A farmer of great practical experience elsewhere visited Cornwall, where he was tempted by that experience to hold it in preference to the local practice there. He took a large farm near Bodmin. Now, his practical experience had taught him the value of deep ploughing on the farm he had just left. His new neighbours were, and are,

contented with shallow work. They manured with sand, and had constructed the Bodmin and Wadebridge railway—the first in the west of England—to reduce their expenses of transit of this sand from the sea shore. The new comer ploughed his land, and ploughed deep. He added a due quantity—as was usual with him—of "food" for his plants, say manure. He looked for crops in their season; finding none, he became demented, and the sport of the street arabs.

Again, we have at page 553 what M. Payen found when analysing the sugar cane. If that able chemist found no more than is there tabulated, are we left to infer that there is no more to find? If so, then the task of manipulation must be a very easy one, and our loss of more sugar than is sold must be intensely disgraceful to all concerned. But the fact is that he did find much more, which more it is of the highest importance to know fully.*

In the very able paper by Dr. Wallace "On Animal Charcoal," we have recalled to memory many of the impediments to success in

* The analysis of the cane given in the report presented to the Reunion Chamber of Agriculture was summarised, and was only intended to show the amount of *salts and silica* absorbed by the cane from the soil. The following is Payen's complete analysis:—

Otaheite Cane at Maturity.

	Centesimally.
Water	71·04
Sugar	18·00
Cellulose, liqueous matter, pectin, and pectic acid	9·56
Albumen and three other nitrogenous matters	0·55
Cerosine, green matter, yellow and other colouring substances, fatty matter, resin-essential oil, aromatic matter, and a deliquescent substance	0·37
Insoluble salts, 0·12; soluble, 0.16. Consisting of phosphates of lime and magnesia, almuina, sulphate and oxalate of lime, acebates, malate of lime, potassa and soda, alkaline chlorides and sulphates	0·28
Silica	0·20
	100·00

the proximate process also. They are here reproduced, where their functional activity is again recognised. That activity is necessarily in a less degree than in the elevated temperature of the tropics, and the mischievous effects are consequently less prompt here. Our old enemies, the albuminoids, are there with gummy matters, and denounced, together with their products by fermentation, and the long list of organic acid-products is nearly full.

What contributed to my great pleasure was the consummate tact, the tact of experience, with which the talented author avoids these acid products, together with the necessity for neutralizing them by lime. The Frenchmen pronounced lime to be a "defecator," and many remain satisfied with the dogma, and helplessly continue to use lime. Now, every scientific chemist knows full well that lime is a destroyer of sugar, rather than a defecator, when boiled in the melange which the juice, as it comes from the mill, affords. It is stoutly contended that it is impossible to make sugar without lime, and it is an undoubted fact with some. Yet such a fact does not disprove another fact, that more sugar of a better quality has been produced from the same quantity of juice, from same mill, and collected at the same time, without an atom of lime being used. It was far superior in crystal, and in colour, and in genial sweetness, being *entirely free from the bitter acetate of lime*. No lime was used, simply because fermentation and its acid products were avoided; therefore lime was not required to neutralize them. If acid, or acids, had been present, of course they must have been neutralized, or we should not have had a crystalline sugar product; and, to neutralize such acids, lime mnst have been used in preference. We had no acid, and required no alkali, nor the mysterious rigmarole of defecation by lime.

I am tempted to offer these remarks on facts which originated in "the boiling house," in confirmation of Dr. W.'s position, and as an interesting coincidence of the unity of theory and experience.

Yours obediently,

W. E. GILL.

46, *Mortimer Road, De Beauvoir Square,*
London, N.

EXPORTS FROM HAVANNA AND MATANZAS FROM JANUARY 1ST TO THE 3RD SEPTEMBER, IN THOUSANDS OF TONS.

	1870.	1869.	1868.
Great Britain	161	136	161
United States	152	155	144
Northern Europe	10	9	15
France	42	44	39
Spain	54	40	41
Southern Europe	3	2	3
Other Ports	7	6	7
	429	392	410
Stock in Havanna and Matanzas	56	64	68

MAURITIUS—TOTAL EXPORTS FOR THE SEASON, 1869-70, FROM 1ST AUGUST TO THE END OF JULY.

	1869-70.	1868-69.	1867-68.
	Tons.	Tons.	Tons.
To England	38,241	22,156	51,895
,, France	11,155	5,269	1,655
,, Australia	46,205	32,952	34,580
,, New Zealand	3,633	2,862	—
,, Cape of Good Hope	2,245	841	1,873
,, Bombay	29,492	13,450	25,751
,, Other ports	1,277	777	742
TOTAL	132,248	78,307	116,496

PRESENT SEASON'S SHIPMENTS FROM MAURITIUS FROM 1ST TO 23RD AUGUST.

	1870-71.	1869-70.	1868-69.
	TONS.	TONS.	TONS.
United Kingdom	610	....	807
France	....	....	....
Australia	....	1,555	598
New Zealand	....	300	....
Cape of Good Hope	121	66	3
Bombay	2,815	....	568
Other Ports	106	145	31
	3,652	2,066	2,007

ESTIMATED YIELD OF BEET-ROOT SUGAR ON THE CONTINENT OF EUROPE, FOR THE SEASON, 1870-71, COMPARED WITH THE TWO PREVIOUS SEASONS.

(From Licht's Monthly Circular.)

	1870-1.	1869-70.	1868-69.
	Tons.	Tons.	Tons.
France	300,000	285,146	213,904
Germany (Zollverein)	225,000	215,407	208,140
Austria	170,000	151,354	101,602
Russia and Poland	155,000	132,500	87,500
Belgium	50,000	43,552	37,078
Holland, Sweden, and Italy	15,000	12,500	10,000
Total	915,000	840,459	658,324

STOCKS OF SUGAR IN THE CHIEF MARKETS OF THE WORLD ON THE 31ST OF AUGUST, IN THOUSANDS OF TONS.

	1870.	1869.	1868.
United Kingdom	181	133	130
France	34	32	52
Holland	39	43	40
Six other *entrepôts*	6	4	5
Germany (Zollverein)	2	3	3
United States	141	146	116
Havanna and Matanzas	56	64	68
TOTAL	459	425	424

CONSUMPTION OF SUGAR IN EUROPE AND UNITED STATES, FOR THE YEARS ENDING 1ST AUGUST, IN THOUSANDS OF TONS.

	1870.	1869.	1868.
Europe	1,338	1,248	1,175
United States (Year ending 31st August)	470	406	404
	1,808	1,654	1,579*

* In the above table in last month's issue two figures were misprinted. Consumption in Europe in 1870—For 1,836 *read* 1,336. Consumption in Europe in 1868—For 1,868 *read* 1,168.

SUGAR STATISTICS—GREAT BRITAIN.

To 22nd Oct., 1870 and 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	38	2	2	16	58	29	104	16	8	46	175	148	75	15	8	30	128	152
British East India	12	2	..	..	15	14	8	2	..	..	10	21	10	3	..	..	13	15
Mauritius	4	1	..	..	5	4	14	3	7	5	29	18	13	2	9	5	29	22
Cuba	6	4	2	16	27	32	11	16	32	86	145	106	14	16	30	76	137	94
Porto Rico, &c. ..	4	5	1	1	11	7	8	21	2	6	36	20	7	18	1	5	31	17
Manilla & Java ..	27	14	..	..	41	50	15	16	3	3	37	49	24	9	3	4	40	39
Brazil	..	16	1	5	23	17	1	42	4	16	63	59	1	33	4	13	51	63
Beetroot, &c.	1	1	..	2	4	2	16	6	3	16	41	26	17	7	3	17	44	27
Total, 1870 ..	92	44	5	42	184	155	176	123	59	177	536	446	160	104	59	150	474	430
Total, 1869 ..	88	29	5	33	Increase29		172	88	56	131	Increase90		156	96	56	122	Increase44	

STATE AND PROSPECTS OF THE SUGAR MARKET.

During the last month the deliveries have continued to increase largely, and the imports to decrease. The latter are 10,000 tons less for the month than during the same period of last year, though for the ten months they are still greatly in excess. Stocks in Great Britain have decreased 27,000 tons during the month, and are now only 29,000 tons in excess of last year, and very little in excess of the same date in 1868.

Prices of nearly all descriptions have ruled decidedly firmer, and an advance has been obtained on most, but relatively greater on the lower and medium sorts. Thus, whilst No. 12 Havana is quoted 27s. 9d. to 28s.—about 6d. more than last month—fair to good Bahias are now worth 18s. 6d. to 21s.—1s. 6d. to 2s. above last month, and these sorts are now on the average 4s. per cwt. less than a year ago, instead of 6s., as in our last report.

Loaf sugar has been in good demand at the advanced prices in consequence of the closing of many French refineries. Common refined lump is quoted at 39/6 to 40/. Pieces and crushed have not shared in this advance, but are dull of sale at a slight reduction in value.

The report that an armistice had been pressed on the belligerents by Great Britain and the other neutral powers tended to stiffen the market, but though the hopes of their success have declined, the market remains firm.

On the continent of Europe, the estimate of the supply of beet sugar is larger than it was a month ago, the increase being chiefly in Austria. It is found in France that the damage hitherto done to the beet crops by the invading armies is comparatively small; and, contrary to expectation, labour is plentiful for the gathering and manufacture; but of course there is no calculating what damage the calamities of war may yet effect.

The continued increase of the deliveries in Great Britain, which amounts to 44,000 tons during the last four months, is a very hopeful feature in the market. Its continuance will be the best guarantee for the maintenance of the present improvement.

THE

SUGAR CANE.

REGISTERED FOR TRANSMISSION ABROAD.

No. 17. DECEMBER 1, 1870. VOL. II.

☞ The writers alone are responsible for their statements.

For Table of Contents, see opposite the last page of each Number.

TO OUR SUBSCRIBERS.

THE Act of last Session reducing the postage of newspapers within the United Kingdom one-half, and introducing other changes, also contained a strict definition of what will in future be considered as a newspaper, in order to prevent literary magazines from coming within the operations of the Act. Hitherto many periodicals not strictly newspapers have been, on small annual payment, allowed the privilege of being "registered for transmission abroad," which has given them the right of postage to all parts of the world on the same terms as newspapers.

The proprietors expected that *The Sugar Cane* would have come within the new definition, it being the organ of a special interest (the cane sugar industry), and not simply a magazine; but the Post Office authorities have decided that it is not sufficiently ephemeral in character to be considered a newspaper. The consequence is that after the end of the present year *The Sugar Cane* will come within the regulations of the book post. This will make no difference as to cost of postage within the United Kingdom, but will increase it on copies sent abroad. Heretofore, to nearly all British colonies, and to many foreign countries, the

postage has been one penny; after the end of the present year the lowest rate to any colony will be threepence per single copy.

Although the provisions of the new Act press rather hardly on *The Sugar Cane*, and will materially increase the current expenses, the proprietors hope that, with their constantly-increasing circulation, it will not be needful for them to increase the terms of subscription to their colonial and foreign subscribers to cover this extra postage, especially if those who find the magazine valuable to them will lend their aid by inducing others to become subscribers, so that the circulation may increase in still greater ratio than at present.

As the privilege of registration for transmission abroad is continued till the end of the present year, the next number of *The Sugar Cane* will be published a day or two earlier than usual, in order to bring it within the old rate of postage; but we may remind those of our home subscribers who re-post their copies to friends abroad that it must be done within eight days of date of publication, or they will be charged the book-post rate, which rate will of course apply to all future numbers, whenever posted.

The proprietors again have pleasure in thanking their numerous friends for their constant support, and in stating that the circulation of *The Sugar Cane* continues steadily to increase. As the present number concludes the second volume, title-page and index are appended.

ON THE USE OF LIME.

By Alfred Fryer.

(Continued from page 637.)

The experiment in page 637 shows that the acid found in raw sugars is partly volatile under the heat and time there given, and partly fixed. A second experiment made with a sample of very

good concrete, containing less than half the amount of acid found in the Porto Rico concrete gave the following results:—

		Acidity calculated as lime per 100,000 lbs. of concrete.
Solution of concrete 1·298 sp. gr......	=	41
Concrete re-made from the above solution in a small model Concretor	=	27

Thus 34 per cent. of the acid was driven off by the process of re-manufacture. In the case of the Porto Rico concrete 36 per cent. was driven off, from which it would appear, so far as the experiments have gone, that about one-third of the acid found in raw sugars may be driven off by heat, and that this proportion holds good whether the amount of acid be large or small.

A solution of concrete was heated with sulphuric acid, in order to ascertain the amount of mischief it effected in the production of uncrystallisable or inverted sugar. Concrete was selected in preference to sugar, as a solution of the former most nearly resembles clarified cane juice. Good Trinidad concrete possessing an acidity requiring 51 parts of caustic lime per 100,000 of concrete to neutralize it, was dissolved in water to a specific gravity of 1·055 ($7\frac{1}{2}$° Baumé), and a little sulphuric acid added so that the total acidity was expressed by 156 parts of caustic lime required to neutralize 100,000 parts of concrete made from such solution, of this solution 300 cubic centimetres were boiled for 40 minutes in an open porcelain dish, by which the specific gravity was increased to 1·305 (34° Baumé). A second portion of the same liquor before it was acidified, a further portion neutralized with clear lime water, and another portion made alkaline to the extent of 70 parts of caustic lime to 100,000 of concrete were heated in the same manner; lastly, a portion of the acidified solution was exposed for 15 hours at a temperature of 80° Faht.

The results on analyzing these samples, in all cases calculated on to concrete containing an equal amount of foreign matters, water, &c., of 10 per cent., were as under:—

CONCRETES—ACID, ALKALINE, AND NEUTRAL.

SAMPLE.	Crystallizable.	Uncrystallizable.	Foreign Matters.	Percentage of Uncrystallizable on the total Sugar.
Concrete untreated	85·5	4·5	10	4·9
" acidified and concentrated	82·5	7·5	10	8·2
Concrete concentrated, not acidified	86·2	3·8	10	3·9
Concrete concentrated after neutralizing	85·9	4·1	10	4·6
Concrete concentrated alkaline	86·1	3·9	10	4·3
Concrete acidified and exposed for 15 hours, at 80° Faht., not concentrated .	86·1	3·9	10	4·3

The first point that attracts attention in this experiment is that the concrete untreated seems to possess slightly more of uncrystallizable sugar than several of the heated portions. This must not be attributed to any improvement that the treatment could effect, but to something accidental in the selection of the samples. The small amount of mineral acid added has produced no mischief in the 15 hours during which the solution was exposed to the low heat of 80° Faht., and no mischief befell those portions that were either alkaline or neutral, or that portion which contained the natural acid of the sugar—one-third of which we may expect from previous experiments to be driven off during the process. From this series of experiments we learn that excess of lime produces no beneficial effect, so far as the composition of the concrete is concerned; but excess of lime is well known to blacken the glucose present, and thus darken the whole sample. It is therefore manifest that the best result is produced by making the solution neutral, at any rate where the concretor is used, but, whether when the solution is subjected

to prolonged or excessive heat an excess of the alkaline earth is needed to protect the cane-sugar, a new series of experiments will be required to determine. The mischief that has been produced by the small portion of sulphuric acid is very marked, the uncrystallizable sugar having been increased in quantity from 4 or $4\frac{1}{2}$ parts to $7\frac{1}{2}$; and when it is borne in mind that the total amount of acid is by no means large, the harm which acid has produced is very serious.

Another series of experiments has been instituted with a view of ascertaining the amount of mischief produced by definite quantities of sulphuric acid. The solutions were treated as explained in the preceding series of experiments, but were made from a somewhat better sample of concrete. The first column of figures shews the degree of acidity imparted by sulphuric acid; the second column, the acidity found in the concrete; the third column, the total amount of acidity. The acid columns show the number of parts of caustic lime required to render neutral 100,000 parts of concrete so acidulated. The fourth column shows the degree to which the concentration was carried. In estimating the amount of mischief effected by the acid, it must be remembered that it is much less than might be expected on the large scale. In the first place, the time under treatment was only about 40 minutes, and the concentration was in most cases only carried until the solution attained the consistency of molasses, and the large surface and small depth of solution displayed in an evaporating basin keeps the boiling point as low as possible. Reference to page 630 will shew that the ordinary amount of lime used, represents an acidity in the juice equal to 250 lbs. of lime to the 100,000 lbs. of concrete, and if this quantity is required to make the juice neutral, this figure may be taken to represent the usual degree of acidity in the juice, and yet one-tenth part of this degree of acidity, when produced by sulphuric acid, increases the uncrystallizable sugar by more than 50 per cent. The rapid increase in the proportion of uncrystallizable sugar, consequent on the increase of sulphuric acid, is in the highest degree worthy of attention.

Concrete and Sulphuric Acid.

Sulphuric Acid.	Natural Acid.	Total Acid.	Degree of Concentration.	Crystallizable Sugar.	Uncrystallizable Sugar.	Foreign Matters.	Percentage of Uncrystallizable on the total Sugar
Untreated	30	30	....	87·43	2·57	10	2·85
26	30	56	Clear Proof.	85·4	4·6	10	5·11
76	30	106	Clear Proof.	81·8	8·2	10	9·11
126	30	156	1·319	71·0	19·0	10	21·1
176	30	206	1·335	38·4	51·6	10	57·4
276	30	306	1·315	4·2	85·8	10	95·3

But surely the acids to be contended with are not so harmful as the mineral acid thus operated upon. In order to determine this with accuracy a further series of experiments has been instituted in which acetic acid has been substituted for sulphuric acid. Here the results are widely different. A very marked effect is produced by concentration with only a minute addition of acetic acid to the natural acid found in the concrete; and whilst the mischief increased with increased portions of acetic acid, the ratio of increase was very small, and evidently some causes were at work that were being overlooked. Thus 176 parts of acetic acid produced less mischief than 26 parts of sulphuric acid, and the difference was in no way traceable to the greater intensity of sulphuric acid, because the measures are all taken in terms of the amount of caustic lime they could neutralize.

Concrete and Acetic Acid.

Sulphuric Acid	Natural Acid.	Total Acid.	Degree of Concentrat on.	Crystallizable sugar.	Uncrystallizable Sugar.	Foreign Matters.	Percentage of uncrystalizable on the total Sugar.
Untreated	30	30	....	87·43	2·57	10	2·85
26	30	56	1·286	86·25	3·75	10	4·49
76	30	106	1·280	85·63	4·37	10	4·86
126	30	156	1·315	85·64	4·36	10	4·85
176	30	206	1·277	85·20	4·80	10	5· 4
276	30	306	1·289	84·46	5·54	10	6·16

It became needful to examine whether any sensible portion of the added acetic acid was driven off during concentration. To ascertain this, a solution of concrete about the density of good cane juice was treated with acetic acid equal to that which would require 216 lbs. of lime to the 100,000 lbs. of concrete to neutralize it, and after 89 minutes boiling it was reduced to grain, by which time the acidity was reduced to 53 parts. But the concrete contained 30 parts of natural acid, of which 10 parts are estimated to be driven off, so that 33 parts of the added acetic acid have remained, and 183 parts have been driven off. This accounts to a large extent for the comparative innocuousness of acetic acid. In the experiment last detailed, the per-centage of uncrystallizable sugar had increased from 2·7 to 12·3 nearly five fold, proving incontestably that even this comparatively mild acid is sufficiently terrible when the concentration is carried to the granulating point.

Concrete and Acetic Acid Shewing what Proportion of the Acid is Volatile.

	Gauge Baumé.	Temperature Faht.	Minutes under heat.	Acidity Calculated as lime per 100,000lbs	Natural acidity.	Artificial acidity.
Cold............	12°	64	—	246	30	216
Boiling..........	10°	212	14	245	30	215
,, ...	23°	214	39	129	25	104
,, ...	34°	220	69·	96	22	74
Remainder brought to grain	..	220	89	53	20	33

All the experiments point conclusively to one fact, viz., that acid whether in large or small amount, and whether organic or mineral, always produces uncrystallizable sugar; and its energy in this respect is proportioned to the intensity of the heat to which the sugar is subjected, the duration of time it is exposed to such heat, and the amount of acid. Mineral acids produce more mischief than organic ones.

ROYAL BOTANICAL GARDENS, MAURITIUS.

New Varieties of Cane, &c.

The Report of the Royal Botanical Gardens, Mauritius, for 1869, dated 2nd August, 1870, contains, beside an account of the state of the gardens, (the alterations and improvements, the new plants and seeds imported, &c.) many remarks of great importance to the colony generally, and even of wider interest.

Our readers are aware that since the prevalence of the cane disease in Mauritius a considerable number of plants of varieties new to the island have been imported from nearly all parts where the cane is grown. These plants have been propagated in the Royal Botanical Gardens in order that it might be ascertained what species are best adapted to the climate and soil of the colony. As the result of the experience thus gained, the report gives considerable information of a very valuable character, which we transfer unabridged to our pages.

Cane Propagation Expenses and Receipts.

The expenses of the propagation, &c., of the new varieties of sugar cane in Mauritius, up to the end of July, amount to £449 4s. 0½d.; and the receipts to date are £926 4s.

Canes Injured by the Radiation of Heat.

In clear mornings preceded by calm clear nights in the cool season, the leaves of the canes are loaded with dew in bright globular drops, covering the leaves and hanging from the points and margins.

From the rapid condensation of moisture, and the radiation of heat, during such nights, the leaves become tender, and if one touches them in the early morning, while the drops of dew are still on them, they feel nearly as cold as icicles.

In the bright mornings which generally succeed these calm, clear, and cold nights, the first rays of the sun strike the dew drops, converting them into lenses which burn the leaves of some varieties in spots, and causing always the greatest injury to the tenderest kinds.

EXPERIENCE GAINED WITH THE NEW VARIETIES OF SUGAR CANE.

As some experience has been gained with the new varieties mentioned in the last report, a few remarks on each may not be uninteresting.

Teboe Nyamplong, is a slow growing cane when young, but after the leaves of its canes have formed, it grows rapidly, and will attain a height of from 8 to 12 feet in a single season. In Java it is said sometimes to grow to 26 feet in length. It is a fine cane of ordinary size, gray colour, and souches remarkably well as a virgin and repousse cane. It is of ordinary hardiness.

Teboe Socrat (No. 1) alias *Teboe Hauermeera*, is a large cane of rapid and upright growth, does not souche freely, and should be planted thickly in the rows. It is of a dirty reddish color marbled with gray or light blue. In good land and in warm and moist seasons it will not bear forcing with guano.

Teboe Lielien, is a small flowering cane, but it souches enormously, and although highly recommended from Java it does not seem to answer well here. The plants of it in the Gardens have grown well, and although its canes are smaller than a cane of ordinary size they are in greater abundance; its plants have not answered expectations at "Mon Plaisir," nor have they given satisfaction in other quarters.

Teboe Kœning Pœlœ Penang, is a fine straight growing flowering cane, rapid in growth, but does not souch over freely. It should be planted thickly in the rows.

Teboe Malaman, is a small cane of a dirty reddish color, changing to green as the canes grow old, souches well, but is somewhat tender. The parent plants in the Gardens have grown well, but those at "Mon Plaisir" have done poorly, which may in some extent be accounted for by an excess of iron in the soil in which they are planted there. It suffers a good deal from radiation, and the variety is scarcely worth cultivating.

Teboe Abœ, is a tender flowering cane, of ordinary size, very much given to "arrow." In one locality, at "Mon Plaisir" where it is planted, it was almost killed in the last cold season by radiation; but a later plantation of it made in another place has

not as yet been injured. Though it flowers early and freely, it is not likely to become a favorite.

Teboe Meera, is a fine cane upright in growth, of a dark red color when young, marbled when old; it flowers but not very freely. It has suffered a good deal at "Mon Plaisir" from an excess of iron and poverty of soil. It souches not over abundantly and should be planted somewhat thickly.

Teboe Rappœ Var, is a very fine cane, grows straight, souches as a virgin and repousse cane in an ordinary manner. Like the variety *Koening P. Penang*, it is blueish-red when young, changing to a greenish-white as it grows old, but unlike the last named variety, which flowers when its canes are from 12 to 15 months old, it does not flower until its canes are 20 months or 2 years old,—even then not freely. It has proved to be hardy in all the places in which it has been tried. It grows rapidly, and in good sites and favorable season, it will attain a height of from 12 to 15 feet in about 12 months.

Teboe Bantong. Although this is a fair sized spreading cane which souches well, I have not a favorable opinion of it. It is slow in growth, even after its canes have formed. Being planted between two other canes on the same day, its growth was choked by them. Its trial was therefore not a fair one.

Teboe Ardjoeno, is a very fine cane of upright growth, attaining a height of from 10 to 15 feet in a year. In color it somewhat resembles *Rappoe Var*, but unlike that variety it has shown no sign of flowering, although there are plants of those kinds, of the same age, growing side by side in the same spot. Its canes also are generally smaller.

Djoeng-Djoeng (No. 2), is a fine cane of a chalky gray colour when young. It is of ordinary size, spreading in habit, souches well, and grows rapidly. I have found it to be hardy in the dryest and dampest parts. It has the appearance of a cane that would yield a large quantity of sugar.

Teboe Itam. Black Cheribon or Black Cane of Java, is spreading in habit, souching well, does not grow very rapidly, prefers a damp situation to a dry one, is of ordinary size and hardiness, and

a cane that is likely to yield sugar well. It greatly resembles the "Canne Belouguet," but is darker in color.

Teboe Hauer, souches well, grows slowly, is of a rosy colour changing to green. The plants of this cane received from Java and planted in the Gardens near water, have not grown well, but the canes cut from them and planted in a dry situation at "Mon Plaisir" have done much better. They evidently prefer a dryish soil.

Trinidad, resembles *Teboe Meera* very much in all its stages of growth; but it seems however, to be more hardy, darker in color, and does not flower so freely.

Guiana cane is a very fine green coloured cane, souching well in virgin and repousses, spreading in habit, should be planted thinly in the rows; it is moderately large and hardy in damp as well as in dry sites, grows to about from 7 to 10 feet in a season, flowers early and freely.

Chigaca, a new Caledonian variety received from Queensland, is a very fine blood-red cane, souches very freely, should be thinly planted, hardy, grows rapidly after the canes have been formed at the base, and to a good length and size, flowers freely and early, but it will not bear rapid forcing in moist and warm seasons. In June last year, several holes were planted with it in the gardens—one eye only to a hole. The canes produced have been cut some time ago, with the exception of those of one plant, which were left growing with a view to ascertain to what size they would grow. There are about 30 of them averaging 8 feet in length. This cane has also done well at "Mon Plaisir." The late Dr. Meller sent a variety of this cane *small Chigaca* from Queensland, but I have failed to see any difference between the varieties.

Djoeng djoeng (No. 1) is a fine hardy cane, striped green and yellow, grows rapidly after its canes have been formed, attains a good size, spreading in habit, and requires to be planted thin in the rows, is hardy in dry as well as in damp situations, but prefers something between these. It looks like a cane that would yeild a good supply of sugar.

Teboe Portii, is a chalky gray colored cane, of ordinary size,

spreading in habit, souches fairly, prefers a damp situation, highly spoken of in the Straits. From appearances it seems to me that it would be one of the best sugar producing canes in the colony, but it requires a damp situation and any place dryer than Pamplemousses would not suit it.

Teboe Rappoe, is a striped cane, resembling the "Canne Gingham," spreading in habit, souches well, and is a hardy, fair sized cane. We have 8 or 9 varieties of this cane from Java, but excepting this, *Rappoe var*, and the *White Rappoe* or *White Aboe*, and those hereafter alluded to, the others are worthless and need not be mentioned.

Teboe Socrat (No. 2), habit of growth upright, should be planted thickly in the rows, souches pretty freely in virgin and repousses, averaging 10 ordinary sized canes to the hole, grows rapidly from 8 to 12 feet in a year, flowers freely and early in the season. This cane in many respects resembles *Rappoe var*, *K. P. Penang* and *Arajoena*, and differs chiefly from these in flowering more freely, and much earlier in the season.

Yellow and Green cane, grows as rapidly as any cane in Mauritius, upright in habit, does not souch freely, averages from 6 to 10 canes from one eye and sometimes yields as many as 25 each of the largest size. This cane in good land requires very little manure, and in damp and warm seasons it will *not* bear forcing with guano. Its leaves are large, and those of the heart are held tight in the sheath, from which they slowly emerge; and if forced in moist warm weather the cane and the heart leaves are suddenly enlarged, without a proportionate enlargement of the sheath; hence it arises that the heart of the cane is strangled, and the cane ceases to grow and becomes diseased. Its canes in the gardens and at "Mon Plaisir" never have the semi-strangled appearance in the cold season that they have sometimes in the hot and moist weather of the summer months, as will be seen more distinctly when they are planted in rich soft soil and immoderately fed with a forcing manure. The repousses of one or two plants of this cane have been allowed to grow, and the following is the measurement of two of their canes, nine months old:—One is 10 feet long, 8½ inches in circumference

at 3 inches from the root, and 7 inches at 6 feet; the other, a common sized cane for this variety, is 12 feet in length, 6 inches in circumference at 3 inches from the root, 7 inches at the middle, and 5½ inches at the top. This is said to be a favorite cane in Queensland, from whence Dr. Meller forwarded a large supply.

Anson Cane, from Penang, is a very fine white or green cane, spreading in habit, souches well, grows rapidly, flowers freely and early. It is not, however, a very hardy cane. Its leaves are tender and suffer severely from radiation.

Ribbon Cane, New Caledonia, forwarded from Queensland. This is a very fine cane, striped green and pale red, spreading in habit, of ordinary size, hardy, souches abundantly, grows rapidly, flowers freely and early. On examining the plants of this cane at "Mon Plaisir," a plant was noticed producing green instead of striped canes. On further examination two other plants were found, one of which was producing striped canes from one eye, and green canes from another eye, both of which *eyes* belonged to the same piece of cane, while the other plant was producing both striped and green canes from one and the same eye.

Black Cane, New Caledonia, from Queensland, Dr. Meller. Is a very hardy cane, souches freely, grows rapidly, flowers early and freely. Judging from its appearance it can only be recommended for its hardiness.

Besides the above, Dr. Meller sent from Queensland the following varieties, viz.:—No. 1 vide *Black Cane;* No. 2 see *Teboe Mheera*, *Chigaca small*, see *Chigaca Djoeng-djoeng* No. 1, *Rappoe var*, *Lielien* and *Portii*.

Jamaica Cane. Is the same as the variety from British Guiana, *Guiana Cane*.

Canes from Egypt. As a quantity of these canes was distributed when they arrived they need not be further referred to here.

Canes from India.

In March 1869 the following canes were received from India:—*Somsarrah*, *Cutarrah white*, *Cutarrah red*.—*Cutarrah white* is a very fair sized cane, souches well, and grows rapidly, but is tender and

suffers very severely from radiation. The other two varieties are worthless.

CANES FROM JAVA, 1869.

In June the following new varieties were received from Java, and were planted in the Gardens. Those that were considered useful have been cut for propagation—*Zepara*, 2 plants; *Rappoe* (a worthless variety), 6 plants; *Kehkes*, 2; *Rappoe Maeda*, 2; *Koening*, 4; *Tezal Warroe*, 17; *Hauer Mheera*, 2, see *Socrat* No. 1; *Ardjoeno* (No. 2), 2; *Rappoe Koening* (apparently a worthless variety), 2; *Aboe White* or *White Rappoe*, 10. The last is preferred in some localities in Java to *Teboe Itam*, and in others the latter cane is the favourite. Both are fine canes.

FROM JAVA, 1870.

Teboe Assep, 2 plants; *T. Zepara bima*, 6; *T. Passaar*, 6; *T. Kiong*, 1; *T. Passaeraewan*, 3.

FROM BRAZIL, 1869.

Of these canes the following have grown, viz:—*Canne Impériale*, 8; *C. Verte*, 6; *C. Ribbon*, 2; *C. Uba*, 6 (a worthless variety); *C. St. Julien*, 4. Four of these are apparently fine canes, and have been cut for propagation.

FROM REUNION, 1869-70.

From J. C. de Mazérieux, Esq., President of the Chamber of Agriculture, Reunion, were received *Canne Martinique*, 19; *Canne Impériale*, 4, and 8 of a very fine, large, rough, dark green, unnamed cane; *Canne Mazérieux*.

LAVIGNAC CANES, 1870.

James Currie, Esq., presented the Gardens with a complete collection of Mr. Lavignac's New Caledonian canes, which, with the exception of two or three varieties, are doing well.

CANES FROM NEW CALEDONIA, 1870.

Growing, *Do-omo*, 2 *plants; Tiboo*, 2; *Rhi*, 2; *Bouron*, 7; *Bouron oapoa*, 4; *M-merai*, 1; *Bati*, 2; *Monanion*, 2; *Tikona*, 44; *Tangio*, 6; *Ouata nute*, 3; *Chigaca*, 12; *Nagamié*, 3; *Rinaio*, 1; *Kanangari*, 2; *Ani*, 1; *Guiname*, 2; *Guinapassa*, 3; *Tombiamié*,

1; *Tombiapa*, 3; *Onata*, 2; *M-ma*, 3; *Djoombakomay*, 2; *Tischi-epa*, 1; *Onboonontona*, 1; *Barotamié*, 1; *Isumba*, 3; *Koembié*, 3; *Ischikanemba*, 3; *Naga*, 39; *Guinabhi*, 1; *Wagaisy*, 1; and of numbers 0350, 1; 0340, 3; 012, 1. The names of the last three varieties have not yet been received.

Many of the above are very weak, most of them newly received, and it is doubtful if they will all live through the dry weather.

From the Sandwich Islands, 1870.

Two wardian cases of canes were received from Dr. Hillebrand, Honolulu, containing 6 varieties; but fron the length of the voyage, six months, only three of them survived, viz.,—*Puaolle*, 2 plants; *Kakeo*, 1; *Kakonakona*, 2. The first named is said to be a very hardy cane, and grows from the sea shore to an elevation of 2,200 feet above the level of the sea; and it is said, when planted in rich lands and under irrigation, to yield an average of 6 tons of sugar to the acre, even in continuous patches of 30 acres.

The great prevalence of the cane disease not only directed the inhabitants of Mauritius to the necessity of obtaining new varieties of cane, but also to the importance of not relying so exclusively as they had done heretofore on one staple article of culture and manufacture, especially as large districts of their island, unadapted for the cultivation of the cane, were mostly uncultivated.

Several species of *Cinchonas* (the plant yielding quinine) have been propagated in the gardens and other parts of the island, but with what result as to pecuniary profit cannot yet be estimated.

Many fibre producing plants are very common in Mauritius; parcels of several of the most useful fibres obtained from these were in the early part of 1870 sent to England for valuation, the result of which is appended to the report of the Royal Botanic Gardens.

Many of these fibres would it appears be available as substitutes for, or for mixing with, the Manilla hemp, an article which is becoming scarce and dear. The various reports as to the values of

the different fibres vary very materially; one London firm estimates them as worth £30 to £70 per ton, but the London rope manufacturers put a much lower valuation on all, some being stated to be only fit for paper making and therefore only worth £11 or £12 per ton. But this is exceptional, the valuation of the London fibre brokers averaged above £35 per ton, and in Manchester the fibres were valued at from £20 to £60 per ton.

Thousands of acres in the dryer part of the island are, it is said in the "report," available for the growth of fibre producing plants, some of which require cultivation, but the greater part of which will grow everywhere in abundance apparently without care. The great difficulty at present appears to be the want of a proper machine for separating the fibre, but this difficulty will it is apprehended soon disappear, as the Indian government which is interested in the production of fibre in some parts of Hindostan, has lately offered a reward of £5000 for the production of a machine best suited to this purpose.

It is further stated that in the higher part of the island there are extensive districts of waste forest lands, where the cultivation of sugar is unprofitable, on account of the low temperature and from other causes, but where the land is well adapted for the cultivation of coffee; most of it being capable of producing 900lbs. per acre per annum; and it must be remembered that the necessary buildings and machinery for pulping, &c., on a coffee estate of say 300 or 400 acres cost less than half what are required on a sugar plantation of the same size, and that though the yield of coffee is very much less than of sugar, acre for acre, the labour required is also less in proportion, and the value of the same weight of each greatly in favour of coffee.

The introduction of new articles of culture and manufacture into colonies in which sugar has been hitherto not merely the staple, but almost the only article produced, is a question of great importance, and one which deserves careful consideration. In many of our colonies there is no doubt but that divers other valuable articles of consumption or export might be produced without the average yield of sugar being materially reduced.

SUGAR IN ST. HELENA.

(*From The Sugar Cane in Australia.*)

Now that the subject of sugar cultivation has become one of paramount importance to Queensland, and that many small capitalists have already, and doubtless many more will, turn their attention to this branch of industry, perhaps a few remarks, detailing my own experience as a sugar grower and manufacturer, may not be out of place, as I consider it behoves every man connected with such an undertaking in a young colony like this to give others the benefit of his experience as far as possible. I allude the more especially to small capitalists, as I am prepared, in the course of my few remarks, to demonstrate the fact that sugar can be both grown and manufactured advantageously, by simple machinery, and at a very moderate pecuniary outlay, provided only the cultivator and manufacturer be possessed of an average amount of ability, perseverance, and industry. From the nature of my ordinary duties, I have been precluded from visiting any of the older sugar manufactories in the colony for the purpose of obtaining an insight into the routine required to be adopted, or the machinery necessary for making marketable sugar. I have, therefore, been under the necessity of studying such works upon the subject as were available, and of perusing the columns in the *Queenslander* devoted to that purpose; and I am happy in giving my testimony to the fact that many of the suggestions thrown out by its contributors have been acted upon with very satisfactory results. I had no previous knowledge of any branch of either the growth or manufacture of sugar. My remarks will, therefore, be entirely devoted to giving my own practical experience during the last two years. In the commencement of the month of January, 1868, it being thought advisable to attempt the culture of sugar cane on the island of St. Helena, with a view of making the penal establishment thereon as nearly self-supporting as possible; ten acres of scrub land were cleared and prepared to receive plants. We then obtained a number of plants of the Bourbon, Yellow, and Ribbon canes; these were cut into sets, and planted in rows six feet apart, and at a distance of

three feet between each plant. In the course of two months about one-third only of the whole had struck, and therefore I had to re-plant the ground; whilst five canes, kindly furnished me by Mr. Hill, of the Botanical Gardens, and which were planted in single joints at the same distance, struck in every case. This I then attributed (and I now find justly) to the latter canes being much fresher, and to the superiority of the canes themselves to the plants previously received. In the following season (September, 1868) sufficient plants were received for ten acres of ground, which were accordingly planted in a similar manner, and of these again only about one-third came up, and the ground had to be re-planted, at a heavy sacrifice of time; while from the proceeds of the five canes obtained from Mr. Hill, I had sufficient single-joint cuttings to plant other ten acres, every stool of which struck, and the greater portion of which will be fit for cutting during the present season. Thus these five canes, in one season, produced an equal number of superior plants to those for which a sum of £30 was paid. It would, therefore, appear advisable, where a sufficiency of fresh canes cannot be obtained for planting, that intending growers shonld plant a few canes only of each sort the first season (which would be growing while they are stumping and clearing the ground), the yield from which would give them cuttings that might be depended upon, instead of procuring at a heavy cost plants which are not likely to be quite fresh, and which might cause them annoyance and positive loss, by having large portions of the ground unproductive for a whole season. The chief reason why I advocate setting fresh cuttings is that long exposure to the sun and air dries up the young buds, after which they will not germinate.

In planting cane since that time, I have tried various other distances between the stools, and would recommend, for a greater benefit to the expected crop, that the furrows should be eight feet apart, and the sets planted in the furrows two feet from each other. By adopting this plan, the canes receive more light and air (very necessary when the cane is ripening), they are more readily kept clear from weeds, and are in a much better position for trashing.

The distance mentioned will also permit of the ground being occasionally turned up with the plough during the time the cane is growing, instead of going to the cost of hand labour, the difference in the two processes being considerable; but the greatest advantage will be found when preparing for the second and future crops. In opening out new ground, I would plough twice thoroughly, and if the subsoil is of a tough nature, would go over the field with a grubber, and then harrow the whole, so that its various constituents may be well pulverised and mixed. Plant furrows might then be opened eight feet apart from the centre, and not less than a foot deep. In these furrows, at every two feet, loosen the earth well round the bottom, and place a piece of cane (from three to four joints, if possible), cut clean at both ends, in an inclined position, at an angle of forty-five degrees, with the buds facing upwards. Cover these plants or sets lightly over with (say) an inch of mould, and as they germinate, gradually fill up to a level. When the plants have grown to a height of about three feet, commence hoeing up round the roots, as with maize, which will leave a hollow between the rows for the trash or withered leaves to fall into and accumulate, ready for being turned into the ground, and so forming manure for the second crop. Trashing should be done twice during the season; but on no account should a single leaf be removed until it is thoroughly withered and is quite dry. I was misled with regard to trashing by some self-constituted authorities on sugar cultivation, who visited the island in its early cane-growing days, and commenced trashing when the leaves were partially green; but it was soon found that it caused great injury to the canes, stopping their growth and reducing their nourishment. The best times for trashing are immediately after the lower leaves are withered, when the cane is rather more than half-grown and the barrel commences to harden, and again about a month before maturity. By adopting this plan both sun and air exert their influence upon the canes, which is very essential.

In cutting ripe canes, care should be taken to cut them with a sharp instrument (a bill-hook answers exceedingly well), as close to the ground as possible, as the lowest joints contain the densest

sap. Immediately after the crop is removed, the stools should be cut down at least three inches under the ground, leaving a clean bare crown, so as to give the ratoons, or second crop, a solid and permanent support. The plough might then be run between the rows, and as close to each side of the roots as possible, until the space between is thoroughly broken up. All trash previously taken from the canes, the tops and leaves thrown on one side when cutting, and the megass, or cane refuse, which has been compressed at the mill, should be carefully packed in between the rows previous to ploughing, so that it may be mixed in and covered by the loose earth, and decompose. This will be sufficient manure for successive crops, provided the ground be occasionally loosened near, but not close to the roots.

The foregoing treatment is recommended supposing the rows to be eight feet apart; if they are at a less distance, most of this work will have to be done with the hand hoe, as the horse or bullock implements would be likely to destroy the young canes, by not having sufficient room for the movements of such labour. In loosening the ground after the cane had grown to some height, the horses would be likely to injure them with the swingle-trees. Besides, close planting is a great drawback when the canes are arriving at maturity, as they grow too rank and dense; the circulation of air and light is withheld from them and prevents their ripening, more especially upon moist ground. I observe that in the West Indian islands the whole of the megass is used as fuel, and the consequent result has been that the ground has become comparatively barren for want of proper nourishment. Chemists inform us that if the whole of the trash and megass is returned to the soil, that is sufficient manure to keep the ground in good vigour. In China, where we are told the cultivation of sugar has been carried on for thirty or forty years without re-planting, the success is attributed to the generous treatment the soil receives. The trash and megass is there used for manure, the ground occasionally turned over, and in very dry seasons irrigated. In virgin soil, therefore, like that of this country, with a little care at the commencement, and the substitution of coal or wood for fuel, so as

to allow all the trash and megass to go for manure, surely the soil can be retained equally prolific.

Planting may be commenced at any season of the year except winter, but the best months are September, October, November, and December, and an average crop will mature in about fifteen months. I find that cuttings make but small progress when put in during the dry summer months; but that canes planted during the wet season grow both stronger and higher. Six acres of Bourbon, from cane of island growth, planted in March of the present year (soon after the first very heavy rains), are now as far advanced as canes planted six months previously.

If the opinions of agricultural chemists were always correct upon the kind of soil necessary for the growth of sugar cane, many would be deterred from attempting it. The formation of this island is volcanic, and the soil contains great quantities of ironstone, and is, therefore, diametrically opposed to what by many has been considered necessary for sugar cane, and yet it has been successful. I hope that others with land of similar formation will meet with a like result. The first eight months after planting there was not a shower of rain, and yet all the canes that appeared above the surface kept steadily growing, certainly not so well as they would have done with occasional showers, but yet sufficient to prove their durability in dry weather. During the rainy season, canes in red soil grow very fast, and I have repeatedly noticed that joints formed during that time are very much longer and thicker. Some Bourbon cane, planted from cuttings of island growth, have measured ten inches in circumference at the bottom of the barrel, and were of a density of $10\frac{1}{2}°$ to $11°$; of course this size is exceptional. If, in a sugar plantation, irrigation to a moderate extent could be carried on, I have no doubt it would prove highly remunerative. In most works upon the treatment of canes, I find it laid down that good plants can always be obtained from the green tops of the canes, whilst the joints of the canes for planting are almost ignored. The five canes previously mentioned as having been received from the Botanical Gardens were planted in parallel rows, one joint to each stool, commencing with the thick or lower end to the very

top, and the canes produced in each row were better in proportion the nearer the plant had been to the lower end of the cane. I have tried this plan since with some Chinese and Salangore canes, that I also received from the Botanical Gardens, with a similar result. I am, therefore, convinced that a cane of far better quality can be produced from cuttings of the mature cane than from the green tops. The cane that appears to flourish best on St. Helena is the China (which seems to be a species of the Ribbon), but the Bourbon, Ribbon, and Yellow thrive remarkably well. A few plants of Black Java are growing, and seem strong and healthy, but none have yet come to maturity.

If possible, it would be more satisfactory to the cultivator if he could lay out his land into blocks (by roads say half a chain wide) of about five acres each, or according to the size of the plantation, to preserve the crop in case of fire.

Having endeavoured thus far to give an opinion regarding the culture of sugar cane, I must defer to a future communication the few remarks I purpose making upon its manufacture, which I have been enabled to effect at a comparatively very small cost, with simple machinery.

The mill now at work at St. Helena is a low priced but good machine for parties cultivating from ten to thirty acres of cane. It is a vertical horse-power mill, obtained from Messrs. Smellie & Co.'s foundry, Brisbane, at a cost of £120. This mill consists of three vertical rollers, each 18 inches in diameter, 15 inches high, and well secured with iron bolts through cast iron plates at the top and bottom. With us, the lower plate is imbedded into a strong frame of hardwood. To secure an elevation sufficient for the fall of the juice into the clarifiers, and from the evaporating pans, the mill is erected upon rising ground, by which means a fall of about 5 feet was obtained, and this was found sufficient for all purposes. A passage 10 feet wide and 6 feet high should be made under the horse walk, which allows of a dray being backed clean up to the rollers. Megass and other refuse can be taken away by the same means. The mill is placed about 20 feet from the end of the boiling house, to give the horses a

sufficiently roomy walk. The horse shafts or poles—18 feet long, and four in number, so that two or more horses can be employed at one time—are best supported by a rod of 3-inch iron, 12 feet high in the centre, and four rods of 1-inch iron from the top of the centre rod to within 3 feet of the end of each pole. Swingle-trees for the horses should be made fast with a single bolt through the pole, so that it will work on a pivot, and give the horses an even pull. For a mill of this power six horses are necessary to work (say) ten hours a day; and if kept steadily at work during that time, sufficient cane could be crushed to produce liquor for about half a ton of sugar. That no time might be lost in changing horses, I would suggest that a shed or stable be built in close contiguity to the mill, to hold the necessary relays.

The boiling house at St. Helena is 40 feet long by 25 feet wide, with 12-feet wall plates; it is built of hardwood and pine, and covered with shingles. There are six windows on each side, part Venetian work and part glass, with an open space of about 18 inches on either side, near the eaves, the full length of the building; there is also a turret, 3 feet square, on the top of the building, filled with louver boards, which completes the ventilation. In this building are fitted the clarifiers, evaporating pans, and tache. The two clarifiers, each capable of containing two hundred gallons, are at the end nearest the mill, and connected therewith by a galvanised iron pipe, through which the juice is conveyed. They are set in brickwork, with separate furnaces and flues, the latter leading into the main flue. They are so placed that the bottoms of the clarifiers are 4 inches above the top of the evaporating pans, and at a right angle with them. The furnace, tache, and evaporating pans run along about 4 feet from one side of the building; the whole of the pans are set in brickwork, with a main flue passing underneath them and between the clarifiers. The furnace for this battery of pans is of Brisbane fire-brick; it is 7 feet 6 inches long, 2 feet wide, and 2 feet high, arched over with a curve 5 feet 6 inches by 2 feet; the tache hangs at the end of the furnace, the bottom about 2 feet above the bars, whilst the brickwork is arranged for the fire to play all round it. The end of the

evaporating pans is 14 inches from the lip of the tache. The evaporating pans, of iron, are joined together, and present a surface 18 feet long, 3 feet wide, and 18 inches deep, which is divided into three compartments. The flue passes under the whole length of them, between the tache and the clarifiers, having a damper at the far end. This flue is 2 feet wide and 18 inches high, and the whole range is built so that the furnace, tache, and evaporating pans fill up the space between the end of the building and the clarifiers. The length of the flue is 45 feet from the front of the furnace to the base of the chimney. The chimney, 4 feet 6 inches square at the base, is of brick, on a stone foundation, and is 29 feet high, with a 6-inch batter on each side. The furnace door is outside of the building. Brickwork is carried 12 inches above the lip of the tache, and is then covered with sheet lead down to the lip, the form being dished out on the side nearest the evaporating pans, so that the syrup, when boiling over, may flow into them. Both the evaporating pans and the tache may be at the same elevation. The edges of the evaporating pans are bound round with hardwood batten, to keep the iron from bending. Our coolers are 5 feet by 4 feet at the top, and 12 inches deep, bevelled on either side about 3 inches; they are of 1¾-inch cedar, and answer well, although the wood for the first day or two slightly discolors the sugar; this, however, may be avoided by filling them with boiling water two or three times. The drainers are made of the same material, and are 5 feet long by 3 feet wide and 18 inches deep, bevelled 6 inches, with a false bottom of perforated zinc, and a hole at the end for molasses to escape. We are now trying another plan, which, I fancy, will drain the sugar better still—that of putting canvas bags for drainers over false bottoms made of narrow battens. There are, however, so many different drainers in use, that experience is necessary to determine the kind most suited for particular sugars. About thirteen thousand bricks have been used in building the chimney, furnace, and range, but as they were made on the island, and all work has been performed by prison labour, the expense for fitting has not been heavy.

For the St. Helena mill, canes about 4 feet in length fit best;

when of greater length they are inconvenient when passing through. Two, or sometimes three, pieces are sufficient between the rollers at a time; but these must, each as it disappears, be replaced regularly, to ensure uniformity of crushing without more than ordinary wear and tear to the machinery. As the juice reaches the mill bed, it runs into galvanised iron piping, attached to which are two strainers of fine wire gauze, and thence into the clarifiers. After the bottom of one of the clarifiers has become covered with juice, a slow fire is lit underneath, and increased as the clarifier fills, the heat being regulated accordingly. When a clarifier is full, quick lime, previously prepared by mixing it with water until it has attained the consistency of cream, is added, according to the acidity of the juice, and tested by litmus paper, and if the paper retains its original tint, sufficient lime has been added to the juice. No stated quantity of lime can be used with certainty in any particular variety of cane, as its acidity varies considerably; each pan is therefore tested in this manner. We have used lime made from both coral and shells, but find neither answer so well as stone lime from Rockhampton. Lately, I have used bi-sulphite of lime, placed in a small receiver over, and allowed to drop into the clarifier at the rate of about three drops a minute, or about two drops to the gallon. This is found to be a great improvement, and about one-third less lime is necessary in the liquor afterwards. The addition of bi-sulphite makes the sugar cleaner, and, in the event of the juice having to remain in the clarifier for some time, it is prevented from fermenting. It is, therefore, a decided improvement upon lime temper. When the clarifier is full and tempered as above, it is brought up to a heat of 140° Fahrenheit, and stirred well round, so as to diffuse the lime water evenly through the whole body; it is allowed to settle, and then brought up to a heat of from 190° to 200°, and skimmed. The liquor is then allowed to run through flannel bags into the evaporating pans, most of the sediment being retained in the clarifier. Whilst the first clarifier is emptying into the evaporating pans, the second clarifier is filling to undergo a similar process. A fire has before this been lit under the tache, which was previously

filled with water to protect it from injury. The heat from this fire having reached the evaporating pans, the liquor is allowed to boil and evaporate in the three compartments up to a heat of 220°, by which time it has reached a density of 28° by Beaumé's saccharometer; the water is then removed from the tache, and the syrup ladled in from the nearest evaporating pan, and it is then brought to a heat of 228° or 230°, but not higher, as the lower the syrup is boiled up to granulation point the better the quality of the sugar, whilst a more intense heat will probably burn the syrup and discolour it. When it has reached a temperature of (say) 228°, the fire is withdrawn, the damper put down, and the syrup run through a long narrow pine trough to the coolers on the other side of the building, where it is well stirred, and allowed to remain for twenty-four hours. In that time it granulates. From the coolers the sugar is transferred to the drainers, where it is allowed to remain as long as possible, the time required for the drainage of the molasses from the sugar varying with the nature of the drainers and the state of the atmosphere.

Great care has to be taken in skimming and keeping the syrup from boiling over while it is in the tache; and when this does occur, such syrup must be allowed to run into the evaporating pans, to go through the various degrees again with other liquor. By following this general plan, with occasional slight modifications as to temperature, we have been enabled to produce sugar of a good coarse grain and fair average quality; and I have no doubt that, with a little more experience, we shall be able to produce a ration sugar equal to any made in Queensland. Warder Mr. Joseph Brown, who has charge of the manufactory, had no previous experience in sugar making, and yet his exertions, backed by perseverance and care, have been successful, as I have stated.

In consequence of the great difficulty experienced in drying the sugar manufactured here, from the variableness of the atmosphere, a centrifugal machine is being constructed, and which it is intended to work either with a small steam engine or hand labour. From experiments made with a miniature model upon the same principle, there is every reason to believe it will have the desired effect, and

produce a dry sugar rapidly. Owing to the length of time required by the modes of drying already described, and the large number of vessels necessary to contain large quantities of sugar whilst draining, a centrifugal machine must be of great service in getting up sugar for sale without unnecessary delay.

Although the mill above described does its work well, and is very cheap for the money, still improvements might be made at small additional expense. I would recommend intending manufacturers to have horizontal instead of vertical rollers, secured with iron plates, as in the mill described. The rollers to be from 2 to 3 feet (according to the requirements of the manufacturer), with a driving shaft of about 18 feet, and metre wheels on the end, so as to allow the horses, &c., to be worked clear of the mill. By adopting this plan, steam could be applied at a future time, should the owner be so inclined. The horizontal rollers would not be so troublesome to keep clean; and by having one of the mitre wheels a little larger than the other, the speed could be regulated to meet the demand without much additional power being necessary.

A six-horse power mill, with horizontal rollers 3 feet long and 20 inches in diameter (to be worked by horses at first, but so arranged that steam could be applied at a future day at a small additional outlay), would be equal to performing nearly four or five times the work of the one now in use here. With such appliances the manufacturer would be in a position to turn out about ten tons of sugar per week.

JOHN McDONALD, Superintendent.

St. Helena, December 7, 1869.

DR. SEYFERTH'S PROCESS FOR THE PURIFICATION OF SYRUPS AND MOLASSES IN THE MANUFACTURE OF SUGAR.

From "The Chemical News."

The juices and liquors employed in the first extraction of sugar from the raw material it is contained in, as well as the syrups resulting from the sugar refining processes, all generally contain a certain quantity of alkaline substances, varying, however, in quantity with the various conditions of the soil on which the beet roots have been grown and the mode of cultivation. The juice of the ripe sugar cane, however, is at the moment of being squeezed out of the cane slightly acid to test paper. By treating the saccharine juices with milk of lime, several of the bases of the alkaline salts present in the juices are separated from the acids they were at first combined with, and by thus being set free and remaining mixed with the sugar, impede its crystallization. One part of alkaline matter can absorb as much as four parts of sugar; and some kinds of molasses (chiefly from beet root) contain as much as 8 per cent. of alkali.

The means hitherto tried to remedy this defect, viz., neutralization of the alkalies by acids, have failed in practice, chiefly for two reasons: first, because the acids have not been applied at such a stage of the process of manufacture as to enable the acids to seize upon the whole of the alkalies: and secondly, because it has never been possible to prevent the injurious effect of even a very slight excess of acid upon the sugar itself; while, moreover, a difficulty is encountered by the very variable quantity of alkali present, whereby the proper quantity of acid to be applied varied every moment, thus rendering their application totally unsuited in any but very skilled hands. Among the acids applied sulphuric and phosphoric have been most used, but their use could not but be very limited, since even a very slight excess thereof was far more to be dreaded, on account of its highly injurious effects upon the sugar, than almost any amount, so to say, of alkalies. Sulphurous

acid has been used and recommended in various forms, even as far back as 1810 (Proust), both on account of its activity as acid in saturating alkalies, as well as its power as a bleaching agent, by thus rendering the sugar whiter coloured.

Dr. Auguste Seyferth, managing director of the Brunswick sugar (beet root) refinery, has hit upon a plan for the use of sulphurous acid, which according to the unanimous and unbiassed testimony of no less than 100 proprietors of establishments wherein the process invented and brought out by the Dr., since September, 1869, is applied, answers the purpose admirably, yielding more produce and of better quality in every respect. The process alluded to consists essentially in the introduction of sulphurous acid, either in gaseous form, or in very weak aqueous solution into the vacuum pans. By this arrangement it is possible to bring all particles of the sugar solution (syrup) into contact with sulphurous acid, and to eliminate, by the joint action of heat and vacuum, any excess of that acid, which, however, not only saturates free alkalies and carbonate of lime, but also sets the organic acids, which might be present as alkaline salts, free from these combinations; the sulphurous acid taking hold of the bases they were combined with, while the greater part of these organic acids are volatilised along with the steam, and thus the sulphurous acid promotes the good and ready crystallization of the sugar, while its action as a decolourizer comes also advantageously into play.

The Seyferth process embraces two main operations, viz., the manufacture of the sulphurous acid as gas, or as aqueous solution, and the application of the acid (chiefly in aqueous solution, being more readily manageable) and its introduction in the vacuum pans. The sulphurous acid is manufactured at the works (beet root sugar manufactories or sugar refineries) by the well known expedient of burning sulphur in suitably constructed ovens, and carrying the products of combustion, previously cooled so as to condense any vapours of sulphur, into a leaden vessel wherein the gas is met by a suitably arranged current of water so as to become entirely absorbed. The aqueous solution thus obtained is put into casks, or other suitable vessels, and from these a tube, provided with taps,

leads to the vacuum pans, wherein the liquid is sucked simultaneously with the sugar solution. The boiler in attendance upon the vacuum pans, while causing the sulphurous acid to be drawn in, takes care to test from time to time (this is done by means of the contrivance technically known as proof-stick) the contents of the pan by applying the blue litmus paper, so as to ensure the contents of the pan remaining alkaline; but if by a mishap the acid is in excess, this is remedied by sucking in a fresh quantity of sugar solution, while a slight increase of the rapidity of evaporation (the turning on of more cold water to the condensers) will rapidly eliminate and volatilize any excess of sulphurous acid, which, when in quantities of 50 to 100 kilos. excess of the weak solution, does not affect the sugar.

The quantity of sulphurous acid solution applied varies from 4 to 8 or from 10 to 15 per cent. of the bulk of liquid (syrup) to be evaporated, but these figures are not absolute but only relative, since experience has already proved that the requirements differ for different localities. The process alluded to is stated to possess, besides the advantages already named (production of better quality and larger quantity of sugar), the good qualities of being applicable at very little cost; to require no inconveniently large space; to be applicable to any already existing manufactory without causing any temporary stoppage of work; its application is readily learned by the sugar boilers. According to the communications made on this subject by the members assembled at the general meeting of German sugar manufacturers and refiners, at Berlin, (last May,) and a similar meeting lately held at Prague, this process is highly appreciated, and largely eulogised as an immense improvement in this branch of industry.

The above article has called forth the following letter :—

To the Editor of the Chemical News.

Sir,—I regret to have to trouble you with the following remarks but I consider it a duty to do so.

You have published, in the last number of your interesting and valuable journal, a notice on a patent, taken by Dr. Seyferth, for

the purification of syrups and molasses in the manufacture of sugar by a sulphurous acid solution.

I beg to state that I carried out the application of this acid in sugar refining so far back as 1850, and sold it to some sugar refiners, who employed it successfully to my knowledge, and no doubt are doing so at the present time.

Dr. Seyferth will find a notice of my process in the *Tecknologists,* vol. xix., p. 478 (1858), and in the *Chemist,* vol. v., p. 344 (1858). There, it is stated that the application of sulphurous acid possesses two marked advantages for the sugar refiner—(1) "That it stops the fermentation of his hot liquors as they come out of the char-filters; and (2), when properly applied, it tends to prevent the re-colouration of the liquors during their concentration in the vacuum-pan. In practice, I find that very successful results were obtained by adding two gallons of a saturated solution of sulphurous acid to 100 gallons of decolourised liquor as it left the char-filter, and was collected in tanks until pumped up or run into the vacuum-pan.

In the same volume (same page), I also described a very simple and cheap mode of preparing hundreds of gallons (per day) of sulphurous acid.—I am, &c.,

F. CRACE CALVERT.

Royal Institution, Manchester.

THE CONTINENTAL BEET CROP.

(*From Licht's Monthly Circular.*)

THE greatest efforts are being made to push on with the gathering in of the beets and all available strength is being turned thereto. But the unfavourable condition of the weather, the generally late beginning as well as the want of competent workmen, through the continuance of the war in France, have caused an almost universal delay, in consequence of which 10 to 14 days may yet be required for the completion of the beet harvest. On this account the reports of the ingathering have been so incomplete that so far no conclusion can be come to as to the result.

Of quantity as well as of quality the accounts received are rather

variable, yet it appears that generally both as to extent and in other respects, things have fallen out still more favourably than have been hitherto anticipated, so that our estimate for the Zollverein might be somewhat raised. Also in the other beet-root sugar producing countries, (except France, of which we shall speak presently,) the beet harvest is, in consequence of the unfavourable condition of the weather, 8 days behind the usual time, still we have from them such favourable accounts of the quantity and quality of the beet that we must bear in mind to raise the estimated yield in our future tables. What has taken place in France latterly, we freely confess is very different from what we anticipated after the capitulation of Sedan and later on of Metz. The conduct of the present French Government as well as the French people is so unaccountable that we can scarcely venture a supposition as to the probable duration of the war, although we might expect that every week would bring the desired peace.* It is very evident that the longer continuance of the war will have considerable effect on the yield of beet-root sugar in France, and it may be considered as certain that our former estimate will not be realized. Nevertheless, our latest accounts state that in the northern departments and in some other districts the manufacture of sugar is going on quietly, and that, in consequence of the relief expected from the Belgian *entrepots* and the Belgian National Bank by the French beet sugar manufacture, prices have advanced 2 francs, *i.e.*, from 53 to 55 francs for sugar of 88 per cent., saccharine value. With this in view, and also bearing in mind that up to this time we have no data for any other valuation in France, and that from other beet sugar producing countries accounts are not precise enough to warrant our altering our estimate of last month, that the possible over estimate of the French crop may be set against the probable under estimate of that in the other beet-root growing countries of Europe, we again present our last month's table of the estimated return of the Continental beet-root sugar crop of the present season in comparison with the yield of former years; [see page 658 of *The Sugar Cane*], by which it will be seen, the present is likely to exceed last year's yield by 73,000 tons.

* It will be seen that M. Licht writes from a German point of view.

YIELD OF SUGAR IN THE MAURITIUS.

(*From the Commercial Gazette.*)

THE figures we publish below afford at one view an idea of the vicissitudes of the colony as far as its production is concerned.

From 59 millions lbs. of sugar in 1843-44 we rose to 316 millions in 1862-63—an increase of five fold in the space of twenty years, notwithstanding hurricanes and all the ills agriculture is heir to.

To reach this figure during the twenty years an immense amount of capital was expended, and no less than 300,000 immigrants were introduced. We thought that the increase of production would continue, and we acted accordingly. We introduced more immigrants without thinking of the consequences as regards public health; the temporary profits realized gave a fictive value to landed property, and as the high raised expectations were far from realized in future years, much money was sacrificed, and the want of foresight in sanitary matters contributed to the sad disasters we had to deplore when disease came amongst us.

Our land no longer yielded as before: disease laid hold of the plant; and the *borer* and *pou blanc* spread rapidly, and called forth all the energy and intelligence of the planter to diminish their ravages. But he could not prevent the decline, and during the last eight years we have never been able to attain the figure of 1862-63. The last crop approached nearest to it, but it was about 50 millions less. It is satisfactory to observe that the crop 1869-70 ranks third on the list, and that it is the largest during the last eight years; it was well it was so after the short crop of 1868-69, which was the smallest made since 1851-52. Having just made 264 millions, there is much to encourage the planter, but as we advance the difficulties that arise increase, and we have to appeal to agricultural science to improve our overworked soil. We have also to introduce new canes, and we shall have to expend a con-

siderable sum to take advantage of the water that falls in the high lands to maintain the fertility of the low, now dried up by the laying bare of the land and the destruction of the forests. When these improvements are brought to bear we may hope for an average of about 250 millions, but the quantity will be liable to variation in proportion to the season, and for that reason the larger crops should enable us to support those which are reduced by drought or hurricane.

The distribution of our crops has undergone great changes. In 1843-44, out of 59 millions, 56 millions or 28,000 tons were sent to England, and only about 100 tons to Australia. Of last crop nearly 80,000 tons or 160 millions were shipped to Australia and India, leaving only about 50,000 tons for other places. England and France together did not take as much as Australia alone—say 98 against 99 millions.

Who would have thought thirty years ago that we should supply part of India with sugar? We have before us a letter written in England in 1836, just after the duty on sugar made in the East Indies was equalized with that of Mauritius and other British possessions. In that letter great fears are expressed of the competition Mauritius will have to support with India, as it is expected the article will be produced much cheaper at the latter place. Last year (ended 31st July) we sent nearly 30,000 tons to Bombay!

After the efforts that Natal has been making to produce sugar it is surprising that any of our produce is required for the Cape, yet we sent as much last year as in 1865-66.

Sugar cannot now be produced here as cheap as it was some time ago. The soil is not so prolific and requires higher cultivation, but it is our conviction that Mauritius can hold its own as a sugar producing country against any of her rivals whether in Europe or the tropics.

Exportation of Sugar from Mauritius to Different Places from the Crop 1843-44 to the Crop 1869-70.

Crops.	United Kingdom.	France.	Australian Colonies.	Cape.	India.	Other Places.	Total.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1843-44	56,941,099	......	213,529	2,370,475	......	20,772	59,545,875
1844-45	73,152,498	......	3,694,450	1,282,030	......	36,128	78,165,106
1845-46	94,837,167	......	4,096,759	3,216,513	......	23,729	102,168,168
1846-47	124,912,296	......	3,856,880	4,304,937	......	336,090	133,410,203
1847-48	103,674,275	......	10,317,053	8,571,344	......	264,616	122,827,288
1848-49	93,953,798	......	7,418,812	4,883,146	......	14,842	106,270,598
1849-50	107,355,498	......	6,432,266	6,233,774	......	501,957	120,523,495
1850-51	106,539,801	......	5,497,469	4,254,903	......	794,233	117,086,406
1851-52	114,859,749	......	9,271,133	13,098,867	......	145,430	137,375,179
1852-53	137,617,792	......	16,230,021	7,395,471	......	84,504	161,327,788
1853-54	173,212,219	349,797	22,992,073	5,836,576	......	881,340	203,272,005
1854-55	153,645,610	26,037,768	26,500,630	11,285,845	......	3,039,182	220,509,035
1855-56	178,176,094	16,867,241	28,885,626	5,816,358	......	338,849	230,084,168
1856-57	125,532,100	48,523,297	37,689,275	7,280,144	......	3,448,702	222,473,518
1857-58	116,896.933	34,337,965	49,273,860	11,767,840	......	5,804,352	218,080,950
1858-59	133,213,960	41,944,694	47,581,513	10,622,440	......	4,536,312	237,898,919
1859-60	108,238,079	59,905,435	43,751,932	10,100,726	......	4,950,140	226,946,312
1860-61	185,572,459	27,399,837	43,053,751	9,258,895	......	6,714,209	271,999,151
1861-62	82,718,558	50,047,715	67,207,552	12,835,521	......	7,607,891	220,417,237
1862-63	170,709,066	42,199,734	69,916,628	13,817,204	17,551,200	2,128,444	316,322,276
1863-64	118,255,069	36,702,080	59,397,235	9,354,230	19,199,598	524,313	243,432,525
1864-65	116,825,885	48,837,456	61,408,877	9,326,914	22,853,945	1,979,974	260,333,051
1865-66	131,463,429	3,620,722	69,623.783	4,486,299	30,708,980	1,513.057	241,416,270
1866-67	51,423,733	11,223,163	100,360,454	6,469,993	44,938,743	2,059,076	216,475,162
1867-68	102,550,997	3,309,362	70,617,653	3,655,330	51,760,761	1,087,583	232,981,686
1868-69	43,808,898	9,957,359	73,420,247	1,507,740	26,658,466	1,210,574	156,563,284
1869-70	76,212,485	22,310,088	99,748,587	4,500,239	58,866,906	2,867,240	264,505,545

COLONIAL CROPS, &c.

The accounts from the sugar colonies are generally much the same as ast month. The reports from Mauritius and Reunion are still worse, and from the former the estimated yield is now only 80,000 tons for the present season, being 50,000 tons less than last. From Java the export of the crop has been delayed by heavy rains. In Manilla, Brazil, the British West Indies, and in Porto Rico, fair crops are looked for. In Cuba some considerable damage is reported in the districts of Havanna and Matanzas as having been caused by a hurricane. It is said that the negro outbreak in Martinique, mentioned last month, has caused the destruction of several plantations; but we shall do well in this case not to ascribe too high a value to these reports, but to take them, as it has been found needful to do regarding the accounts of the insurrection in Cuba, *cum grano salis*.

The stocks at Havanna and Matanzas were on the 1st October 16,000 tons less than last year; the shipments were, according to table, 35,000 tons in excess, of which 25,000 tons were sent to England.

The exports from Pernambuco from 1st October, 1869, to end of September, 1870, were 73,510 tons, against 72,750 tons and 48,624 tons in the seasons of 1868-69 and 1867-68 respectively; and from Bahia 30,985 tons between the dates mentioned above in the present season, against 40,098 tons and 46,657 tons in the two former seasons; whilst the stock at the end of September was estimated at 4,000 tons, against 2,300 and 3,200 tons in 1869 and 1868 respectively.—*Licht's Monthly Circular*.

We learn from another source that "the damage to the cane fields in Cuba, by the late hurricanes will probably be very trifling, the cane that had been laid flat having risen again in consequence of subsequent favourable weather. The apprehensions of a short crop have disappeared, and if the result should be short of last year's it will not be owing to the storms of October, but to other reasons which may yet cause trouble."

ON THE PREVENTION OF FERMENTATION IN CANE JUICE.

TO THE EDITOR OF THE SUGAR CANE.

SIR,

My last communication to you was discursive; I now propose to refer to some of the facts which grow out of, or lead up to, the process of liming, notwithstanding the large amount of ink that has been expended on the subject. The ingenuity displayed in what has been written hereon has been more or less interesting, and so far creditable.

It will suffice our present purpose to touch on, without positively proving, some of the more prominent features, as they come under notice. Our cane juice is admitted to be a compound, and not a simple solution of sugar in water. Again, this juice issues sweet from the cane, to become intensely sour, if simply left to itself. This change is not sudden, but progressive, yet prompt and intensifying. The process is known to chemists as fermentation. The elements of fermentation are already in the juice. These elements may be nicely balanced when in the cane, to fulfil those laws to which they are obedient; or they are sufficiently separated by the delicate cellular tissue of the cane. That delicate partition may be broken down by the mill; that nice adjustment may be overbalanced on exposure of the juice to the varied attractions among the gases which compose our atmosphere. For then we have prompt disturbance and immediate action and reaction. New and varied compounds are the result, and this operation may continue just so long as sugar remains to be destroyed. *Whenever this state of ferment is arrested, short of the positive destruction of sugar, we may indulge the hope of saving a commensurate sugar product.*

It were idle to enlarge here on the many and varied experiments and opinions of Berzelius, Liebig, Schwann, Blondeau, Schmidt, Tyndall, and others who have dived deep into this mystery. Now, although the exciting cause of this fermentation is so subtle, and the caution of scientific men so great, that the point may not be

assumed as decided, yet the balance of evidence appears to be in favour of the view which regards the action of living organisms as essential to the commencement of the process; and the fermentation of cane juice may be another piece of evidence. All, however, appear to agree in recognising the necessity for the presence of some nitrogenous body, and further insist that it is only nitrogenous compounds that are subject to spontaneous fermentation. Compounds containing only carbon, hydrogen, and oxygen, do not ferment, only when in contact with nitrogenous bodies.

Milk contains spores, or eggs, which generate the lactic fermentation. Pasteur has shown us that this lactic fermentation is not confined to milk, but occurs frequently during the decomposition of organic matters. Pelouze observed that, *when a vegetable substance, such as sugar or starch, is put in contact with lime, or other alkali, and an animal—a nitrogenous—substance, lactic fermentation ensues*. Lactic acid, it may be observed by the way, is a syrupy substance, of an intensely acid reaction. Need I also add that albumen is nitrogenous.

We will now advance another step. In the island of Mauritius lives M. Icery, who is not only the owner of sugar plantations, but he has cultivated also an acquaintance with their products, such as enables him to understand what he sees, and appreciate the rumours of tradition at their proper value. In a word, he is M. le Docteur Icery, whose experience has confirmed, or corrected, theory, to enable him to write a most acceptable essay. The doctor herein discovers to us another cause of fermentation in cane juice, which he distinguishes by the general term of "granular matters." He says, "The juice contains albuminous matters, which remain to alter the character of the juice, when separated from the *débris*, and *these granular matters contribute to the fermentation*." He also divides the juice into two parts:—"The solid part, which is granular, and also fragments of tissue, which latter are accidental; and a liquid part, which holds in solution certain organic and inorganic matters." * * * "the globular and the albuminous matters essentially contribute to determine the fermentation, and consequently the acidity of the juice, which is the principal cause of the

glucose transformation of sugar." It appears to me that if we remove these causes of "transformation," we may realise our hope of a more profitable product from the sugar cane. "In fact," says the doctor, "when we obtain a liquor that is perfectly clear and bright, it need only to be mentioned to be understood, and the importance admitted. "*Without doubt it would lead to very satisfactory results, whenever it became the basis of a new process to be applied to our sugar industry. When these essentials are secured, they will command the finest quality and largest quantity of sugar product with perfect ease.*"

In a word, the doctor recognises the destructive effect produced by the presence of "granular matters" and "albuminous matters," together with "the *débris* of the cane," and the result of their inactivity, if not removal, is to realise the contained sugar "with perfect ease." Important and desirable to be understood as these things are, they are for the most part "old familiars." The doctor goes further when he introduces us to one who has been hitherto a stranger to our list of enemies—one who, all but invisible, nevertheless appears to be the precursor of mischief and of possible destruction, this "globular granule."

Ever since the observations of Robert Brown became known, botanists have been acquainted with certain peculiar little granular bodies, which *are met with in the sap of vegetables*, and endowed with a constant oscillatory motion. These extremely minute corpuscles formed the subject of numerous microscopic observations by M. Le Rique de Mouchy and Professor Bechamp. These animalculæ, the microscopists decide, are met with not only in the liquids of plants, but also in those of animals, in the pollen of certain vegetables, in the eggs of butterflies, the liquids of caterpillars, spiders, &c. They arrived at the conclusion, after a lengthened and arduous investigation, that *these oscillating granules are really organised beings—probably some of the most minute hitherto discovered*, and that THEY ACT LIKE FERMENTS.

It is thus we acquire link after link, until we complete the chain of evidence of what appears to be so many independent corroborations of great value. One word more before we part from these

living infinitessimals. Extracted, by very careful filtration, from the cambium of geraniums, lilacs, &c., THEY CAUSE SUGAR AND STARCH TO FERMENT EASILY. The physiological functions of these curious little bodies *appear to reside in the maturation of fruit*, the elaboration and regeneration of tissues, &c.

It is remarkable that in the fermentation and putrefaction, or rapid chemical decomposition, of animal and vegetable bodies, equally the same profusion of the lower forms of animal, as well as of vegetable organisms, characterise the phenomena.

Having fermentation in the juice, its effect on the accompanying sugar is told in the words of Liebig:—"If sugar be mixed with such compounds"—as those already enumerated—"it is decomposed or fermented into alcohol, carbonic acid, &c.; the latter is the shape in which sugar escapes unseen into the air; the remaining portion may afford us vinegar. The molecular disturbances," he adds, "are propagated to the sugar, and by disturbing the equilibrium of forces by which the sugar exists, effects the conversion of the sugar into alcohol, and the other products of the alcoholic or vinous fermentation."

Here then we have, in as few words as possible, traced up this fermentation as near to its source as our knowledge and space can afford. It only remains to enforce the remark that this fermentation is fed and perpetuated by, and at the expense of, contained sugar, which it decomposes. Therefore, the amount of loss of sugar here mainly depends on the length of time from the expression of the juice to the complete arrest of the process of fermentation. Of course this loss may be avoided, by avoiding fermentation altogether.

That this avoidance of fermentation in the juice is at once practicable and profitable I will endeavour to place beyond opinion by narrating a fact, which I can also verify.

I happened to be visiting an esteemed Padre, rector of his parish of Quingua, in a district where I had been an entire stranger. In the evening one of his parishioners called, who is a large planter. Conversation soon drew in the direction of sugar and its manufacture, &c. Among other things, I urged the desirableness

of a better article, and he invited me to his boiling-house the next day. He drove me out. I produced what he confessed was a better sugar. In the evening we met again at the worthy Padre's, when I contended that an improved quality involved an improved quantity also It was agreed now that both these points should be decided on the following day, and the Padre was unanimously elected judge of the results. After chocolate, Don Eustaquio drove me to his large estate. Instead of taking me to the same mill as before, he took me to another, which had finished its portion of work the previous week. The men belonging to it presently came around us, when he told them to do as I wished, as I was going to make sugar on a better plan. The uncut portion of the estate was not far off, whence they could obtain any canes I wanted. He now apologised for leaving, as he had three mills at work, and must needs visit them. He presently sent a young man who could speak Spanish to me, for I was ignorant of the local jargon. When the young man came, these people spoke to him for a few minutes, which he explained to me in Spanish, that they—Indians—said that if what I proposed doing was only a different way to accomplish the same thing—make sugar—was it worth while to trouble themselves to learn my new way, when they knew the old way so well, having been at it all their lives. But *if I could do what they could not do*, then they would help me most willingly. Could I? My reply to this plausible challenge was at once in the affirmative, and my practicals hurried away to bring in canes. They left two to make preparations. These were nearly completed, when I heard the tramp of the buffalo in the mill-path outside, and presently the juice came trickling into the receiver. I saw at once there was something other than I expected. The colour of the juice betrayed the fact of inferiority to any experienced eye. I went out to the mill—which was a very primitive affair, consisting of two vertical stone rollers—preferring my own judgment to any information from a suspected source. I presently found out what *they* meant when they asked, "*Could I do what they could not?*" They had actually collected the refuse canes that had been thrown aside as worthless, and added remnants of canes that had been *gnawn and thrown*

down, from time to time, by a colony of rats—canes which, it is almost needless to add, it was then simply *impossible for them to use,* without spoiling whatever sugar such juice might be mixed with; and time had only made bad worse.

Of course I was in a position to command them to bring me good canes; but was it politic to do so? It would be admitting them to a victory; I preferred to fight for it with my own weapons, and get out of this Indian scrape as best I could.

I allowed the grinding to go on, and they were about four hours getting *the usual quantity* of juice for a pilon—about 1 cwt.—of sugar, of which they gave me due notice. Without further details, I may state at once that I hold the planter's certificate, and also the worthy Padre's, that I then got a first-class, well-crystallized sugar, and 25 per cent. more—after ladling out a "bon bon" to each of my practical witnesses, who keenly watched over the process, as Indians can watch—sugar of a better quality than they obtained from the best canes of the same field. An Indian yell characteristically closed the performance.

I apprehend that if the fermentation which the rats had induced had not been arrested, we might have had vinegar, but assuredly no sugar. Therefore, to arrest this fermentation at the onset, may now appear to be practicable and profitable. As it may be difficult to suggest a more severe elucidation in practice of the important fact, I have indulged so far in detail, offering the result as an apology for any seeming egotism.

To return; we have seen, however cursorily, that we get fermentation in the juice, and its acid result. This acid must be neutralized by an alkali, or we get no sugar crystals. This use of lime has been esteemed by the French as "defecating" the juice, which is evidently a misnomer, and "tempering" is equally barbarous.

We may sum up the facts thus. The incentives—albumen, &c.—to fermentation are already in, being component parts of, the juice. Fermentation naturally occurs spontaneously and promptly, and acetic acid is one of the consequences. Now, most of the acids precipitate albumen. The phosphoric and the acetic acids are

well-known exceptions to this rule. They dissolve albumen. If we add to such a solution of albumen in acetic acid an alkali, as lime, the acid immediately forsakes, ejects, or disgorges* the albumen, to unite with—by preference, a well-known preference for—the lime, and we now get the acetate of lime in solution. When this ejected albumen now reappears, it is uncombined with water—it is no longer liquid, but solid; it is detected in small particles—floculencies. Lime cannot collect albumen into such floculencies, it has no such attribute; but it has the power, and exercises it, of destruction of sugar, when boiled in the juice. This has been proved over and over again, and is an admitted fact.

So, then, before we can get these floculencies, we must consent to the destruction of sugar by fermentation, to obtain the acetic acid wherewith to dissolve the albumen, or we may add lime in vain to precipitate any portion of the albumen. The addition of lime can assist fermentation to secure the loss of sugar.

After all we are sure of imperfection by this liming, and of loss of sugar; a large proportion of the albumen remains non-coagulated for contamination and for composing molasses, notwithstanding an excess of lime used to produce an inferior article.

Mr. Alfred Fryer correctly tells us (page 629) that "lime is generally added without rule, and according to the taste and fancy" of the operator, and the operator is usually "an ignorant man." I only add, in confirmation, that such practical ignorance, or ignorant practice, is the rule, and experience proves it to be rather expensive, when losing more sugar in its manufacture than is sold.

I am, yours obediently,

W. E. GILL.

46, *Mortimer Road, De Beauvoir Square,*
London, N.

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* My scientific friends will pardon this attempt at explicitness.

To the Editor of the Sugar Cane.

Sir,

I have been a reader of your Magazine from its commencement, and have looked anxiously to see the ably-written scientific matter it has contained on manufacture and refining, a little more interspersed with something on cultivation, especially as you announced at the outset that you trusted to practical men for contributions to that department of the work. Hitherto, however, your call has been but feebly responded to in this; whether from apathy, shyness, or a certain kind of modesty that esteems our neighbours fitter for the task than ourselves, it may be difficult to judge. I have to confess to the last of such misgivings, but have come to the point of offering you these few notes on the mode of cultivation pursued in this, once the most prominent of sugar producing territories in the world. I am quite aware of the adjectives "old school" and "semibarbaric," often used to qualify this system as well as that the said system is certainly not the most advanced of the age, but taking *results* into consideration, there may be something in it after all worthy of a little notice.

I am situated in the north side of the Island, where the parish is one of the driest, and the soil of a very mixed character, and considered naturally the most unfertile of that of any part of the Island. We have to manure highly for our crops, and it is to this in particular that I shall endeavour to aim my remarks. The manure we place most faith in is that of the farm-yard or cattle pens, made from large quantities of guinea grass, yard cleanings, rubbish hoed from road sides, or waste land, &c., used as foddering for the stock. When about to put in a field of plants we first go over the land with the well known Flying Pen, taking up an acre or half an acre at a time according to the number of stock, and giving it at the rate of 1600 to 2000 head per acre, with from 100 to 150 cattle cart loads of grass and rubbish as fodder. The land, if wet, is then trenched, lined in rows of 4 or 4½ feet square, and dug to the depth of 6 or 7 inches in the old style. Very little use is made of the plough in this quarter; the fields from their position, nature or other impediments, not being well adapted for that implement.

The tops are planted horizontally, generally three to a hole, and covered to the depth of about $1\frac{1}{2}$ inches, or if the land is wet the corn step or space left between the holes is well broken down and the tops stuck in, leaving the cabbage part above the ground. We know that greater width of rows has been advocated and worked to advantage in certain sugar growing countries, but it has been found not to answer here. The plants take longer to cover the land, consequently more cleanings are required, while they stand a greater risk of suffering from the severe droughts that often set in at this critical stage of their growth. We put in our fall plants in November, and spring about April. The canes most cultivated are the Bourbon, White transparent, and the Black cane. The first is best adapted for heavy loam or stiff clayey soils, being very exhaustive and not well adapted for ratooning beyond a second or third crop. The White transparent is the favourite for lighter soils and ratooning land. It has the most tender rind, and is apt to quail in dry weather. The Black cane is very hardy, and thrives to a certain extent in any of these soils, but it is hard of rind and pithy, and is avoided as much as possible, especially on estates where cattle or mule power is used for grinding.

On the light loose soils which readily absorb all surface water and as readily suffer from drought, when the crops begin to fall off, we manure by "fly-penning on the stock," or with dung from the home pen. The former plan may seem ridiculous in the eyes of theoretical or paper planters, but it has been the means of saving many an estate in Jamaica through years of adversity, when managers adopted it in despair, as a cheaper system of keeping up cultivation until better times might cast up. It is proceeded with in the following manner: we cut such a size of pen as the number of our stock will cover, at the rate of 1000 head per acre in five or six nights, foddering with Guinea grass and whatever trash can be spared from the mill for that purpose, at the rate of 50 to 70 loads per acre. When that pen is finished we cut another, and proceed in the same way until the piece is completed. When all the sprouts appear, or about three weeks from the date of cutting, we put hands to dig *supply holes* through the blank spaces, which

are planted in the usual manner, and with a small basket of dung under the tops. When the piece is ready for cleaning the supplies may be so far advanced as to require a little of the *bank*, and at the second cleaning to take it all, and thus the piece is established and probably brought up from $\frac{1}{4}$ hhd. per acre to $1\frac{1}{2}$ hhds. I know fields and even whole estates that have been kept going thus for the last twenty years, where the cost and risk of establishing plants has been found to be such as to prove it folly to open up the land for them. Of course it is only on soils such as above indicated that this mode could answer well, the land being fed and protected by the heavy coating of grass and dung it has received in penning, which manifestly acts as the fertilizing agent, until rain comes to its relief, whilst heavier soils must be opened up to the atmosphere. By this system one-half the cleanings required for plants is saved, besides £2 per acre the cost of digging, &c., and the land is kept perpetually under crop. In manuring by baskets from the home pen the best time to apply the dung is about the month of September. When the canes are beginning to joint, the trash to be withdrawn from the roots and replaced over the dung. From 60 to 80 loads of well made dung applied thus is a very heavy manuring, and ought to tell for three subsequent crops. The blank spaces in this case may be supplied with stocks dug from any piece thrown out for planting, or split from the larger stools of same piece. Canes to be used for *stocks* should have two or three joints before transplanting, and when obtainable thus, and got in in favourable weather, they are the best supplies.

In manuring low-lying stiff land, where close and deep trenches are required, and penning impracticable, recourse is had to a method called hoe-ploughing, or digging round the roots with the hoe, and cutting the fibres so close as to almost undermine the stools—these roots are then filled up with dung mixed with marl or ashes.

From the foregoing it may be seen that, from the variety of our soils, the management of different estates must also be varied. We have estates entirely planting, and others entirely ratooning; but I think the best paying are those partaking of the nature of

both, or intermediate, on which we can continue fly-penning on the stock during the crop months, from January till June or August, and for plants from August to December. On ratooning properties the after months are occupied making manure in the home pen, which of course gives extra work in carting in fodder, and again carting out the dung. I shall conclude with a few facts from observation and experience on an estate of the medium class during the last three years. The total area of the cane-field is 245 acres, from which an average of 12 acres is thrown out yearly for plants, leaving 233 acres of cutting field, comprised as under. The average crop for last three years is 238 hhds. sugar, and 183 puncheons rum. Ditto for last ten years, 248 hhds., 180 puncheons, but during that time some of the most worthless of the land has been thrown out, and planted with Guinea grass.

			Hhds.
12	acres	plants at $1\frac{3}{4}$hhds	21
12	,,	first ratoons at $1\frac{1}{4}$hhds.	15
36	,,	fly penned on the stock and supplied	51
10	,,	basked, dunged, and stocked	12
127	,,	second and third rattoons and old canes	127
36	,,	for fly penning on stock	12
			238

By pursuing the above rotation it will be seen that the field, in manuring, can be returned upon almost every third year. Upwards of 300 acres of guinea grass pasture, carefully cleaned and protected, is required for this, as it only yields one good cutting yearly; these pastures, like cane fields, getting exhausted in time by repeated cuttings, ought to be treated to a little grass manure occasionally. As it is, when one runs out, we replant it, and give it a couple of years to rest. The cost of cultivating the above field is about £600 annually, including making and applying manure, which is the heaviest item, ranging from £350 to £400. Cleaning is carefully attended to, but the field is easily kept in order. Three cleanings, at from 2s. to 3s. per acre, and one trashing at 4s., is generally all that is requisite for ratoons. For plants four or five cleanings and two trashings, varying at rates from 5s. to 8s. per acre, are required.

J. S.

To the Editor of the Sugar Cane.

Dear Sir,

A few months since one of your Jamaica friends asked for suggestions as to the best supposed mode of treating the important article of "cane ash," when applying it to the soil, or cane root. My notion is that by mixing fresh cane ash with stale or acid dunder from the still, and giving it *as mixed*, these will form an ammoniacal salt which may approximate to guano in its effects, and cause *greater* absorption by the soil, than when the ash is put in dry, which is the usual practice, and thus to two elements taken up by the cane will be in part returned to the earth which gave it. Molasses being a known fertiliser, its refuse with ashes may form that nitrogen, of which worn sugar soils are so deficient.

Excuse this, from a very embryo,

"AGRICULTURAL CHEMIST."

St. Mary, Jamaica, 13*th September*, 1870.

Guano, as applied in Jamaica, is simply a stimulant to the *cane*, *per se*, as it does not reach the extreme fibres of the root from which the cane derives its nutriment from the *unaided* soil.

NEW PATENT.—from the Mechanics' Magazine.

923. H. B. Preston, Liverpool. *Evaporating sugar.* Dated March 30, 1870.

This consists in a continuous attached channel or gutter, formed of iron, or other suitable material; shaped like a "Helix," and descending in a spiral direction, widening towards the bottom, and constituting a dome. At the top and centre of this dome is a tank, or receptacle, for the purpose of containing and supplying the cane juice, or other liquid, to the helical channel or gutter, which is heated by a suitable furnace under the dome. At one side of this tank is a suitable supply cock, opening into the upper end of the helical channel or gutter.—Patent completed.

Exports from Havanna and Matanzas from January 1st to October 1st, in thousands of tons, to the nearest thousand.

	1870.	1869.	1868.
Great Britain	167	142	173
United States	165	169	134
Spain	55	41	42
France	42	45	41
Northern Europe	10	9	16
Southern Europe	3	3	3
Other Ports	8	6	7
	449	414	417
Stock in Havanna and Matanzas	32	48	53

Stocks of Sugar in the Chief Markets of the World on the 30th of September, in thousands of tons, to the nearest thousand.

	1870.	1869.	1868.
United Kingdom	186	152	158
France	24	27	48
Holland	30	33	45
Germany (Zollverein)	9	9	15
Six other *entrepôts*	4	4	6
United States	107	121	83
Havanna and Matanzas	32	48	53
Total	392	395	408

Consumption of Sugar in Europe and United States, for the Years ending 1st October, in thousands of tons.

	1870.	1869.	1868.
Europe	1,347	1,242	1,173
United States (Year ending 31st August)	470	410	412
	1,817	1,652	1,585

Present Season's Shipments from Mauritius from 1st August 20th September.

	1870.		1869.		1868.
	tons.		tons.		tons.
United Kingdom ..	611	....	3,330	....	1,926
France	438	....	444	....	210
Australia	1,861	....	4,305	....	3,130
New Zealand......	925	....	1,278	....	224
Cape of Good Hope..	183	....	162	....	136
Bombay	5,209	....	2,637	....	568
Other Ports	122	....	435	....	43
	9,349		12,641		6,327

Bahia—Exports from 1st August to end of September, for last Three Seasons.

(From Licht's Monthly Circular.)

	1869-70.		1868-69.		1867-68.
To Europe	30,346	..	35,604	..	44,003
,, the United States.	608	..	3,890	..	1,689
,, La Plata.........	23	..	600	..	965
,, Africa..........	8	..	4	..	—
Total	30,995		40,098		46,657

Pernambuco—Exports from 1st October to end of September, for the last Three Seasons.

	1860-70.		1868-69.		1867-68.
To Europe	44,009	..	39,605	..	29,020
,, the United States.	8,396	..	11,118	..	3,597
,, La Plata........	9,679	..	8,893	..	7,743
,, Valparaiso	1,826	..	1,067	..	1,521
,, Inland Ports	9,600	..	12,067	..	6,743
Total	73,510	..	72,750	..	48,624

SUGAR STATISTICS—GREAT BRITAIN

To 19th Nov., 1870 and 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1870.	Total, 1869.
British West India	25	1	2	12	40	20	105	17	9	48	179	151	89	17	9	36	150	164
British East India	13	2	..	..	15	16	10	2	..	..	12	24	11	4	..	..	15	17
Mauritius	4	1	..	..	5	3	15	3	7	5	30	18	14	2	9	5	30	22
Cuba	6	3	2	8	18	28	11	17	33	87	149	116	15	17	32	85	150	108
Porto Rico, &c. ..	3	4	1	1	10	8	8	22	2	7	39	23	7	19	1	6	34	20
Manilla & Java ..	28	14	..	..	42	50	19	18	3	3	43	54	27	12	3	4	46	45
Brazil	..	13	1	5	18	15	1	43	4	16	64	63	1	38	5	14	57	70
Beetroot, &c.	2	1	..	4	7	3	18	7	3	22	51	30	18	8	4	22	51	30
Total, 1870 ..	82	38	5	31	155	142	187	129	62	188	566	479	182	117	62	172	533	475
Total, 1869 ..	81	31	5	25	13 increase		182	99	62	137	87 increase		172	105	61	137	58 increase	

STATE AND PROSPECTS OF THE SUGAR MARKET.

THE market has been in a very healthy state during the past month. Notwithstanding the very large deliveries during October, and the rather slackening demand, prices remained about the same during the first week of November. As the month advanced, more firmness was displayed, chiefly because the small supplies of good West India and similar sorts were in few hands, and, in consequence, the business done was at advanced prices, in which advance lower descriptions have participated. It is probable that the failure of the negotiations for an armistice between Germany and France tended to this firmness, as likely to make the manufacture of the beet sugar in the latter country more uncertain. Later on, "The Eastern Question" at one time assumed such a threatening aspect as materially to affect both Foreign Stocks and Consols, yet the tone of the sugar market was not disturbed so as to affect prices in any degree.

The imports for the month have been about the same as last year, the deliveries have been 14,000 tons for the month and 58,000 tons for the eleven months above those of last year, whilst stocks which at one period were greatly in excess, are now only 13,000 tons more than at the same date in 1869.

No. 12 Havana afloat is quoted at 28s. to 28s. 3d., very nearly the price of last year. The average price of refining qualities of British plantation sugar in bond is 22s. 6d. The refined market has been irregular, stoved goods are in demand at some advance, whilst crushed and pieces are dull of sale and have scarcely supported last month's prices.

As regards the future, notwithstanding the partial loss of beet crop in France is regarded as more probable than heretofore, the estimate for the Continent continues the same as last month, being 73,000 tons more than the yield of last season, but this is of course only an estimate, and by no means to be regarded as certain. The reports from most of the sugar colonies are favourable, with the exception of Reunion and Mauritius, from the latter island the deficiency is likely to be 50,000 tons as compared with last season. On the whole there appears to be no reason why the market should not continue firm for some time to come.